
HALF-HOURS
IN
THE DEEP

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THE HALF HOUR LIBRARY

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# HALF HOURS IN THE DEEP

## The Nature and Wealth of the Sea

WITH NUMEROUS ILLUSTRATIONS



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# THE SURFACE OF THE DEEP.

# THE SURFACE OF THE DEEP.

## CHAPTER I.

### MAGNITUDE AND BEAUTY.

THE Great Deep! What a world of sublimity, of countless wealth, of awful power! Let the great deep share man's thought, and it shall inspire his admiration, his wonder, his awe.

Who does not remember his first view of the sea? It was with that view there came the first real sense of tho vastness of creation, of the insignificance of man. Even to childhood's experience the face of the great deep is grand with a terrible splendour; and increasing years, with increasing knowledge of the solemnities and grandeurs of other scenes of nature, leave the peculiar inspirations unrivalled.

Such is the great deep wherever seen. Whether seen in noon, lying beneath the summer's cloudless sun, like

burnished steel; or seen at night, beneath the pale light of the full moon, like some vast desert crossed by a shining silvery path, along which angels have left footprints of light; seen smooth, or rippled, or, risen into stern, wild tempest, in restless fury it rolls, and leaps, dashes against cliffs and clouds—in all its moods the great deep awakens great feelings, feelings which make their subject a humbler, yet wiser and nobler man.

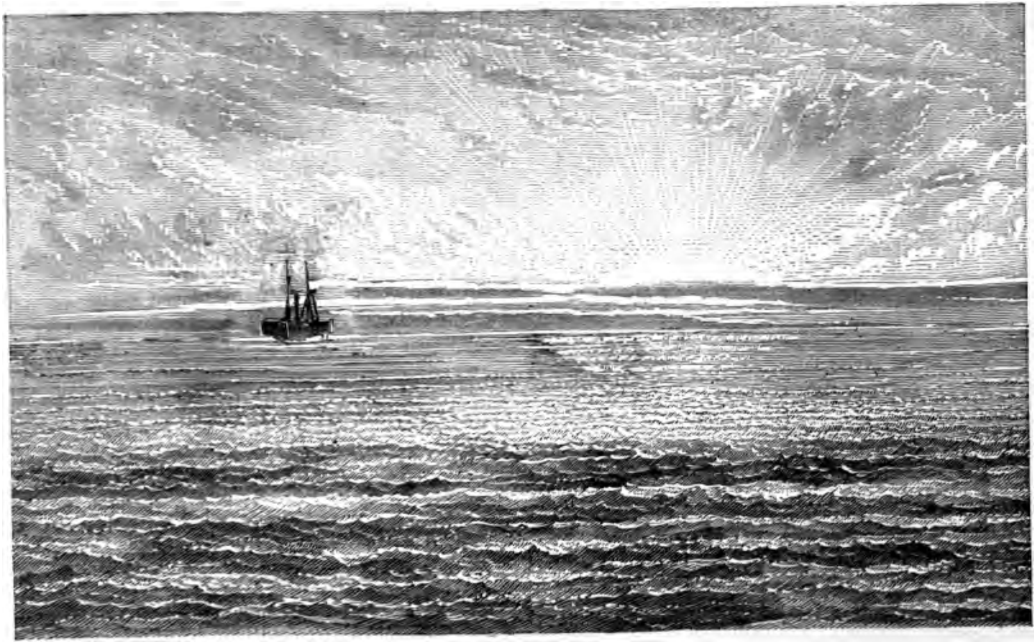
But in the deep what wonders are hidden! In the hills, and valleys, and caverns of its floor what museums and menageries! What wealth of animal and vegetable form and habit! What luxuries of imagination, what treasures of knowledge!

According to Swainson's estimate there are not less than 8,000 species of fishes, 4,500 shell-fishes, 2,500 coral and star-fish, of which the principal proportion are inhabitants of the sea. To these must be added numerous amphibia, ocean and marine plants, worms, birds, &c., and we have the catalogue of the life of the deep.

The following pages present, in systematic order, the principal facts of the physical nature, the population, and the laws of the deep.

But before entering upon these fields of pleasure, let us in fancy wander down to the beach before sunrise on a spring or summer morning.

There is not a breath of wind stirring. The fishermen's boats anchored a little way from shore lie motionless in the calm water. The shores are deserted. Even their feathered visitants, so busy during the day, have not yet



SUNSET AT SEA.

begun their labours. The wavelets, for the tide is full, are gently breaking on the pebbly shore with a soothing murmur, and a narrow fringe of white foam, extending far away on each hand, marks the line where they break upon the shingle.

Seated on a rock, let us observe the gradual birth of the day.

A long line of light marks the edge of the eastern

FISHING-BOAT.

horizon. The few clouds hanging over it are suffused with a roseate hue, suggesting the poet's beautiful idea of the rosy-fingered Eos. Now the colour brightens into a golden tint, the line of light passes into a broad general refulgence, and the sun emerges as if out of the deep. How glorious that long radiant path of light along the surface of the water between the eye and the sun!

Now turn toward the shores. How brightly the little billows are glancing as they fall upon the pebbles! How

much of all this splendour is due, not merely to the direct rays of light which enter the eye, but to those that are reflected from the water, or refracted as they pass through the clouds and appear on the various tints of gold and purple!

From our western shores the view of the ocean at sunset is no less magnificent, touched although it is with a certain sadness that seems to a thoughtful observer to accompany the waning light of day.

Chateaubriand thus eloquently describes a scene not unlike that of sunset from our own coasts in midsummer. He is speaking of a voyage along the shores of Virginia, when the crew of his ship were called to evening prayers.

"The globe of the sun, whose lustre even then our eyes could scarcely endure, ready to plunge beneath the waves, was discovered through the rigging in the midst of a boundless space. From the motion of the stern of our vessel it appeared as if the radiant orb every moment changed its horizon. A few clouds wandered confusedly in the east, where the moon was slowly rising; the rest of the sky was serene; and towards the north a water-spout forming a glorious triangle with the luminaries of day and night glistening with all the colours of a prism, rose out of the sea like a column of crystal supporting the vault of heaven.

"This is a picture which baffles description, and which the whole heart of man is scarcely sufficient to embrace."

# THE SURFACE OF THE DEEP.

## CHAPTER II.

### PROPORTIONS AND USES.

ONE of the first ideas which a contemplation of the globe originates is that of the vast proportion of its surface which is covered by sea. The area of tho Atlantic Ocean alone is twenty-five million square miles, and that of the Pacific Ocean not less than seventy million square miles.

On examining a map of the world, we observe that from the fortieth degree of south latitude to the Antarctic pole, the earth is almost wholly covered with water. We perceive also that the ocean predominates between the western shores of the New World and the eastern coasts of the Old, containing but a few groups of islands throughout the immense intervening space of water.

The proportion of the solid to the fluid surface of

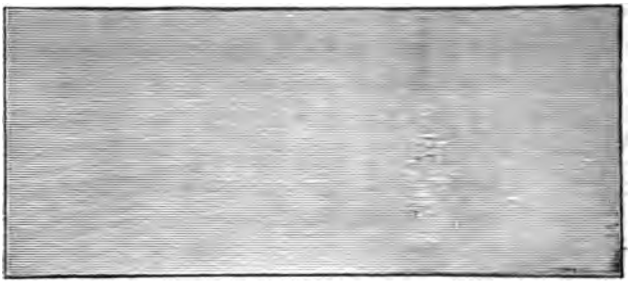
the globe is, according to Rigaud, as 10 to 27; in other words, nearly three-fourths of the globe are covered with water. The accompanying diagrams will aid the conception of this fact.

Now these relative proportions of sea and land are no more accidental than the beautiful and highly organized structures of an animal's body, every part of which affords an instance of wise and beneficent design. They exercise a most important influence on the globe's temperature, on its atmospheric pressure, on winds, on the quantity of moisture contained in its air.

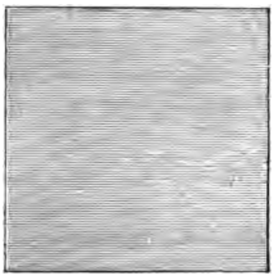
The deep, too, is the parent of all waters: our mighty rivers and lakes were once clouds, and the clouds are but vapour lifted into the sky from the sea by the secret engineering of the sun. The winds fill the cloud-sails and drive them over the land to the hills and the mountains; and there the clouds pour their blessings into mountain springs, on pastures, orchards, and roads, bringing greenness, coolness, and gladness everywhere.

It is the sun-filtered sea which sparkles in the dew-drop, and falls in the summer shower. It nourishes the grass and unfolds the flowers. It purples in the peach, yellows in the apple, and swells in all the grain of harvest. It is this which snorts in the mighty engine, weaves our cloth, saws our timber, lifts our coal from the bowels of the earth. All the water in spring, lake, river, or brook, and every particle in fog, snow, or sleet, is the offspring of the sea.

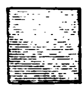
Annually the sun raises from its bosom a quantity of water equal to a depth of fourteen feet over its whole surface. If, therefore, the vapours thus rising were not



Area of Water 144,000,000.



Area of Continents, 50,000,000.



Area of Island, 2,900,000.

RELATIVE AREA OF SOLID AND FLUID SURFACE OF GLOBE IN ENGLISH SQUARE MILES.

arrested in the air and eventually returned by the mouths of its ten thousand rivers, the level of the deep would sink at the rate of fourteen feet per year, and by this

period in the world's history its whole bed would have become dry land.

If we regard the continent of South and North America only, with its deep and wide rivers of fresh water and magnificent inland seas,—if we keep in mind that these lakes and rivers are supplied entirely by the evaporation of the sea-water,—we cease to wonder that the source of a supply so vast must itself be so inexhaustible.

Nor are any of those great rivers greater than is requisite for the requirements of the animal and vegetable world; for, although a large quantity of the water carried down by the rivers finds its way into the sea, it does so only after having been circulated by thousands of brooks and rills, like so many veins and arteries, throughout the valleys and plains, carrying life, freshness, and beauty to places which must otherwise have been as dry and barren as the deserts of Asia or Africa.

The atmosphere may be regarded as the vast distilling apparatus by which the salt waves are converted into pure and fresh water. In evaporation the watery particles alone are raised into the atmosphere, the ingredients previously incorporated with them, and which give them their briny taste, are left behind.

Purer than from the finest artificial still, the sea-water rises up in the air day and night unceasingly, invisible and impalpable, yet in millions of tons. Even the surface of the ice-covered lake, or the iceberg on the

snow-capped mountains, throws forth its contribution to the great aërial reservoir of moisture; for it is remarkable that the surface of the hardest ice in the coldest weather, evaporates nearly as fast as if it were a movable fluid.

SEA-VAPOUR, CONDENSED INTO CLOUDS.

There is another aspect in which we may regard the ocean.

It is the great medium of intercourse between countries remote from each other, the means by which the benefits it confers on all lands as the primary source

of rivers are reciprocated between one nation and another.

"With every wind it wafts large commerce on,
Joins pole to pole, consociates severed worlds,
And links in bonds of intercourse and love
Earth's universal family."

SEA-VAPOUR, RETURNING IN A MOUNTAIN-STREAM, TO THE SEA.

The waters of the ocean indeed unite shore with shore, connecting together the most distant regions of the inhabited world, and rendering every land they wash easy of access. It is evident that if the earth consisted only of dry land, and life could exist under such circumstances, intercourse between remote countries

would be impossible; and when we reflect upon the difficulties which travellers find in passing over a few hundred miles in the centre of Africa, or the interior of South America, when there is no transit by water, and that in the latter continent there are, on both sides of the Amazon, thousands of square miles of country through which the most adventurous traveller cannot penetrate, it is not too much to suppose, that, were there neither seas nor rivers, we should have to this day remained in ignorance of all countries at a great distance from our own.

As the means of communication between different nations, the ocean must be regarded as the means of a rapid increase in knowledge and civilisation.

By its instrumentality commerce has its free course; the temperate regions of the earth can speedily acquire the richest productions of more favoured climes.

Thus, too, we obtain for use in winter the warm furs of the Antarctic seas or of North America. In summer we procure the lighter fabrics produced by warmer climates; for all these commodities we can exchange the productions of our own ingenuity, which could not otherwise be rendered available to distant nations.

Thus the cotton of the West Indies is transported to the looms of Britain, and again in a manufactured state sent to supply the inhabitants of India and China. Thus the riches of the Indies are wafted to our shores, and we are enabled to reciprocate the benefit by a happy and beneficial interchange.

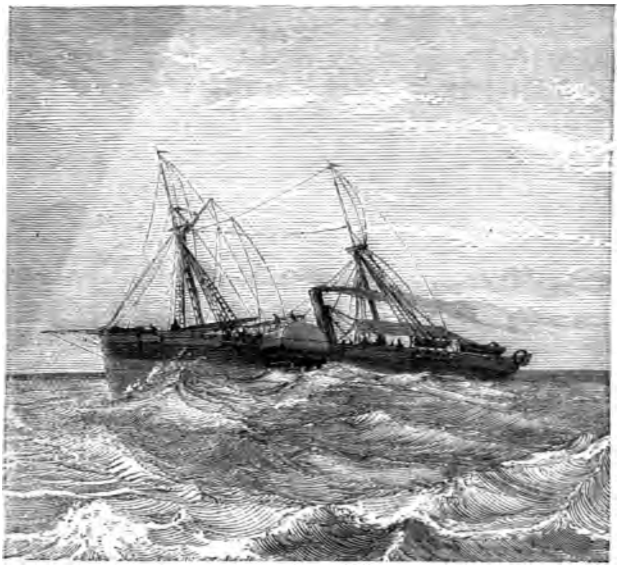
One of the most striking illustrations of the importance of the ocean as the medium of communication between remote countries is the recent employment of steam navigation in our intercourse with distant Australia. Over thousands of leagues the steamship ploughs her way across the pathless deep, carrying the manufactures of Europe to supply the wants of those far-off colonies, and bringing home their gold and their fleeces in return.

But these are by no means the only advantages which the ocean confers by affording the means of intercourse between parts of the earth far removed from each other.

In the earliest history of civilised society, many centuries before the discovery of the New World, the Mediterranean and the adjoining seas, although traversed by timid navigators who scarcely dared to venture beyond sight of land, afforded the means by which the advantages of Roman civilisation were carried to the shores of Britain, whose inhabitants were then little removed from the present condition of the rudest aborigines of America; but since the period of the revival of letters and the coeval advancement of science, how unspeakable have been the benefits which Europe has conferred on remote nations by wafting over the deep those stores of knowledge which tend to multiply and strengthen the moral and intellectual bonds that, like the principle of charity, will, it is to be hoped, yet unite the whole brotherhood of mankind!

The Roman poet was so impressed by the idea of the

perils of the deep to which, in a short voyage from Athens, his friend Virgil was exposed, that he spoke of the sailor who first trusted his frail bark to the waves, as a man around whose heart was a threefold brass of courage and heroism.



STEAMER IN MID-ATLANTIC.

What amazement would have filled the mind of that elegant writer, could he have seen the illustration his metaphorical description has obtained in the immense iron steam-ship, with its marvellous machinery, literally

surrounding the brave hearts of our countrymen as they venture, not along the shores of sunny Italy, or the once terrible Syrtes, but over seas unknown to the ancient world! What flight of poetry would Horace have attempted in referring to the mighty ship, with her hundreds of passengers, her powerful mechanism, and her vast stores of wealth traversing against wind and tide, not some narrow strait of an inland sea, but the vast ocean that lies between the opposite sides of the earth, and carrying with her knowledge and cultivation, liberty and the means of human advancement!

# THE SURFACE OF THE DEEP.

## CHAPTER III.

### COLOUR.

THE colour of the sea has behind it a cause which excites curiosity.

The general hue of the surface of the sea varies greatly. At one time it is a grey or leaden colour, at another a light or a dark violet blue, and again it is of a dead, then of a brilliant green.

All these shades of the surface with their modifications are produced partly by reflection. The surface of the deep reflects the hue of the superincumbent sky, and appears to be of the same colour. Thus, if the day be cloudy and rainy, the surface of the sea is more or less of a leaden or grey tinge; if the sky be cloudless, or a smart breeze blows to the shore, the waters appear blue, the

depth of the colour varying under certain modifications of its causes.

But the sea has other colours besides those occasioned by its reflecting the hues of the sky. It has colour essential to itself.

In shallow places along our shores its colour cannot be very accurately observed. In such places it is modified by the reflection of the bottom: if the bottom be, on the one hand, of fine white sand, or, on the other, of dark rocks, the water assumes more or less of a light or dark hue. It is in the wide ocean that the colour of its waters is best observed.

The colour of the sea-waters varies in different parts of the ocean from light green to dark blue, independently altogether of atmospheric reflection. The waters of the North Sea and of the Polar regions are light green: those of the regions of the trade wind, and especially of the Indian Ocean, are dark blue. The waters of the great current in the ocean called the Gulf Stream, which flows from the Gulf of Mexico towards the Arctic Seas, are of an indigo blue, and afford a striking contrast with the green of the Atlantic through which they take their course.

Probably one of the chief causes of the variety of colour in sea-waters is a difference in their chemical constitution, that is to say, a difference in the quantities, and perhaps proportions, of the salts which they hold in solution.

That some parts of the ocean are salter than other

parts is beyond question. Now the salter the sea-water, the deeper is its blue; and the greener it is, the less is its saltness.

The waters of the Gulf Stream, for instance, are salter

SALT-WORKS BY SEA-SHORE.

than the ocean through which it flows, and their colour, as above stated, is different, being of an indigo blue. That this difference in the amount of the salts they contain is one of the chief causes of the difference of the

colour of the sea-water is further confirmed by the experience of those engaged in the manufacture of salt by evaporation along the shores of Italy and France. The more the sea-water is exposed to evaporation in the vats into which it enters from the sea, the salter it becomes, and it is found that this change in its saltness is accompanied by an alteration in its colour, from the green of its ordinary hue to a gradually deepening shade of blue.

Several writers, some of them recent, but not well-informed on such matters, follow the old authors who have referred to this peculiarity, by repeating their hypothesis, that the saltness of the water is a provision against the stagnation and putrescence of the ocean.

This is altogether erroneous.

# THE SURFACE OF THE DEEP.

## CHAPTER IV.

### ICEFIELDS AND ICEBERGS.

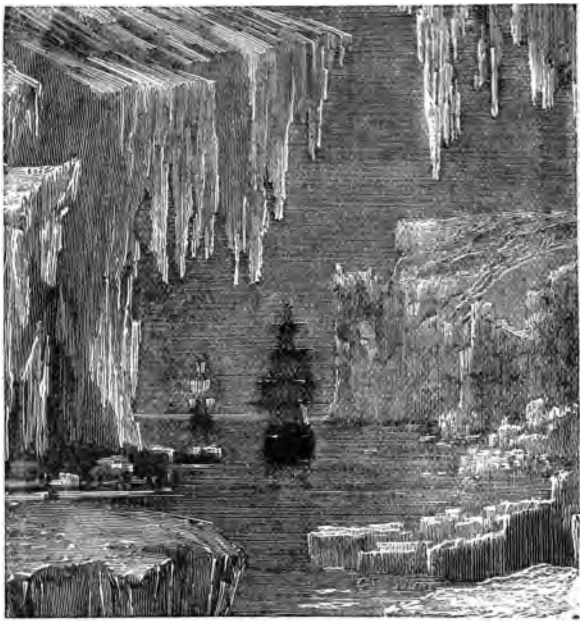
IN considering the magnitude, nature, and uses of the ocean, it must not be forgotten that a vast portion of its surface is not in a liquid state.

Around the poles of the globe, north and south, by the action of extreme cold, the sea is turned into continents of ice. Whilst no ship can traverse it, it affords firm footing for man and beasts.

A more complete idea may be gained of the peculiarities of the frozen sea by the following facts.

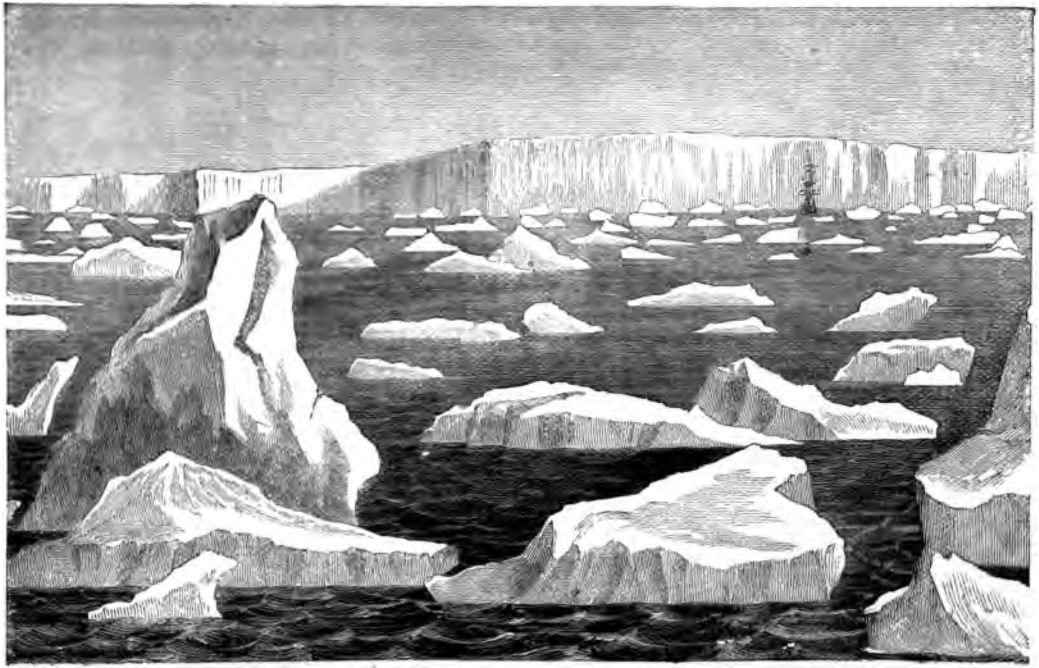
Concerning the Frozen Sea of the Southern Pole, Cook, Ross, and Penny report that there is no indication of a break anywhere along its whole line. Their ships sailed for many degrees along the outer face of an ice-wall, of which the first shelf was as high as their main-

yard. Above and beyond that shelf, as far as the assisted sight could reach, there was nothing but solid ice. In some few places, however, what looked like land backed the frozen fringe.



SUMMER AMONGST ARCTIC ICE-CLIFFS.

The frozen sea of the North Pole is familiar, not to ocean explorers alone, but to every whaler. At a nearness to the pole varying with the season of the year, the



ICE-WALL OF ANTARCTIC SEA.

progress of ships northward is barred by sea changed into ice, shore and cliff.

Dr. Kane relates that he crossed a continent of ice a hundred miles wide, of which the northern boundary was reached in the eighty-third degree of north latitude. There he found an open sea extending in an unbroken sheet of water as far as the eye could reach towards the Pole, the waves broke upon the shore, and there was a tidal variation in the height of the water, the temperature of which was four degrees above freezing. The general idea is that the frozen sea extends to the Pole, but whether this inland sea, or more correctly inice sea, was only temporarily or always free from ice is yet uncertain.

In the summer months these ice continents crack and split into vast mountains of ice called icebergs, which becoming detached, get under way and start for the south. In June they are to be met with in the North Atlantic, sailing majestically to fulfil their beneficent mission to sea and air in warmer regions.

Sometimes the whole continent of ice drifts before it breaks into fragments. Ships that have been surprised by an early winter in the north, and have consequently been frozen up in the sea in which they sailed, report that during their captivity they have been carried long distances by the drift of the mass in which they were enclosed. McClintock relates how the pack closed in around his crew, and cut them off from all power either of advancing or retreating.

At length the ice-field split up into vast masses, like small islands, in one of which the little vessel was firmly fixed.

The next two days after they drifted seven miles westward. Afterwards they succeeded in forcing the yacht a mile and a half through the ice. It again closed in upon her, and in the two weeks that followed, they made by drift only twenty-seven miles. On the 13th of September they were within twelve or fifteen miles of comparatively open water, but the pack held them fast.

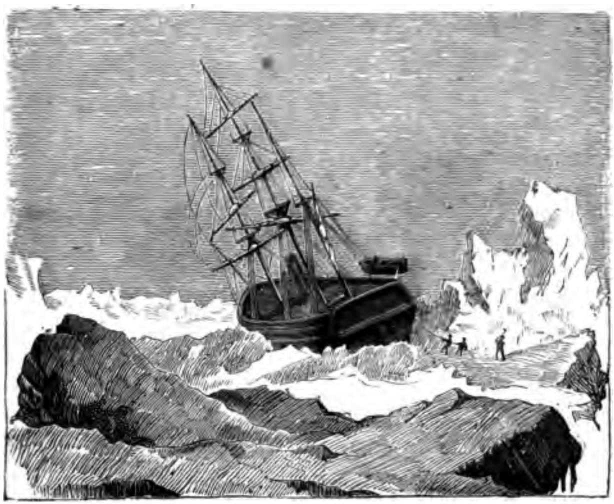
It was clear, at last, that there was to be no escape till spring, and the preparations for wintering were forthwith begun. They faced the gloomy prospect of more than half a year of absolute inutility with cheerful resignation.

And now, too, a steady drift from the north set in, and, day by day, they became aware that, in their icy prison, they were driving farther and farther from their destination. In the course of December they had been carried southwards sixty-seven miles; and when the sun at last appeared above the horizon, on the 28th of January, were close upon the latitude of Upernavick.

During the two hundred and forty-two days in which they had been embedded in the ice, they had been carried southwards no less than thirteen hundred and eighty-five miles. This was the longest drift ever known.

Of the terrible dangers consequent on the breaking up of such a "pack," the following facts give vivid illustration. The lanes of water in the pack now began to open, and

deliverance seemed near at hand, but McClintock had still, however, a perilous race to run before it was gained. While the pack remained entire, they were at least comparatively safe; the danger commenced, in the true sense of the word, when the vessel had to be steered among its shattered and heaving fragments. A week later, and the



IN THE DRIFT-PACK.

great swell of the Atlantic was felt for the first time, "lifting its crest five feet above the hollow of the sea, causing its thick covering of icy fragments to dash against each other" and the little bark. "The pack had taken upon itself," as Dr Kane had expressed it, "the functions of an ocean," and amidst a chaos of contending masses

and shattered bergs, they had to steer their course to the open sea.

By this time the swell of the ocean, covered with countless masses of ice and numerous large berg-pieces, to touch one of which latter must have been instant destruction, was rising ten feet above the trough of the sea. The shocks became alarmingly heavy; it was necessary to steer head on to the swell, which was sufficient to send the waves in showers of spray over an iceberg sixty feet high, as they slowly passed alongside. Gradually, as the day wore on, the swell increased into a sea; but still, as by magic, they escaped all contact with any but the young ice, and, at last, "emerged from the villainous pack, and were running fast through straggling pieces into a clear sea."

"Anxious moments those!" says McClintock. "After yesterday's experience, I can understand how a man's hair has grown grey in a few hours."

A striking instance of escape from danger from icebergs is given by Dr. Kane in his account of his voyage in the Arctic Seas.

One day, whilst sailing between two bergs which were moving towards each other, the ship was suddenly becalmed. Her sails hung loosely from the spars. Not a breath stirred. The towering, heaving masses steadily approached. In a few minutes the doom of the vessel would be sealed.

Whilst in a state of intense agonizing anxiety, they perceived a third and much smaller berg sailing down

between these floating mountains. In an instant they saw that in its course it must pass close along the ship's side. There was hope! Could they but fix their helpless ship to it, it might tug them along with it and deliver them from their approaching awful fate. Not a moment

MEETING OF ICEBERGS.

was to be lost. Quick as lightning a rope was seized, a small anchor attached, and a man stood ready to throw it, the life of every soul on board depending on his success.

The iceberg nears the ship. It is passing by. A strong arm hurls the anchor. It is in the air! Agonizing

moment! Not a soul breathes. Will it hit?—or miss? A deafening cheer breaks forth. The ship moves. "It was an anxious moment," says Dr Kane; "our noble tow-horse hauled us bravely on."

With the success of that admirable throw, danger was not passed. Just as the ship was about to clear the great berg, the yards upon her aft-mast were discovered to be in danger of catching in it. In less time than it takes to tell, sailors fly to the rigging and brace them, and not a moment too soon. A second later, and their ship and fate would have been hopelessly fixed.

Scarcely had her stern left the channel which lay between, when the bergs met with a crash and roar of thunder.

# THE SURFACE OF THE DEEP.

## CHAPTER V.

### SEA-BIRDS.

ONE of the most fascinating studies of nature is the study of birds. By land or by sea, the arrangements of flight are as beautiful as they are varied. With the special wants of the bird are found ever new and marvellous adaptations! How baffling to the ability of man! how superior to all the inventions of science are even the very simplest arrangements of the wing!

The champion of flight is a bird of the sea. In the frigate-bird is the miracle of the wing. Above the ocean it daily, monthly, yearly, maintains its way, never leaving the air except to prepare its nest and to rear its young. Hundreds of leagues away from land, scorning even the bosom of the sea, it delights to spend its sleeping as well as its waking hours in the air.

How is this? It is by the power of his magnificent wing. So vast are its proportions, so admirable its adaptations, that his wonderful feats are accomplished without fatigue and with the very slightest exertion.

But not to wing alone does this animated frigate owe its extraordinary powers. Furnished with hollow bones and an air compartment, into all of which it can force the air by means of its lungs, the bird is able to render itself almost buoyant.

For food the bird descends near the surface of the sea, where its keen eye soon detects suitable fish; and, by a dart, in a moment it is captured. But the frigate is not scrupulously honest. Diving birds, as they rise from the water with their prey, are often robbed by him. Should the rightful owner, tenacious of his prize, take to flight, the frigate can always victoriously pursue; and, should it be necessary for his purpose, can administer vigorous chastisement with his hooked beak and gigantic wing.

His body is about three feet long; his head is small and his neck long. His beak is long and powerful, his feet are small, and from tip to tip his wings are usually about twelve feet.

Less curious, but not less interesting, are the sea-birds of which our own shores afford abundant illustration.

Various species of gulls are common, building in the precipitous cliffs near the sea, or resorting to a solitary island in some distant lake for the same purpose. All of these are remarkable for the ease and elegance of their

FRIGATE-BIRD.

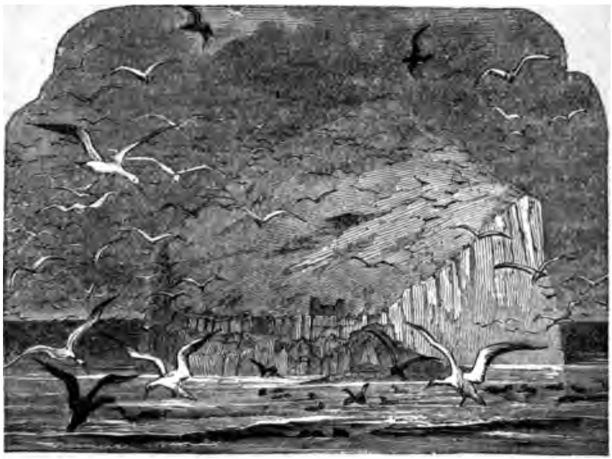
motions when on the wing, and for the power with which they are able to make their way amidst the storm.

To the gull family belongs the Tern, a bird which merits its popular name of sea-swallow on account of its

STORM-PETREL.

shape and its rapidity of flight; the Kitty-wake, so called from its peculiar note; the Fulmar, a large grey and white species; and the Storm-petrel, so dreaded by the mariner as the forerunner of a tempest.

In addition to these, there are many birds which frequent those parts of the sea-shore when the tide recedes to a great distance, leaving bare a long tract of sand or mud, in which they find an ample supply of marine worms and other kinds of food. Among these there are Curlews, Sandpipers, Plovers, and other birds;



SEA-GULL COLONY.

they are, however, as a general rule, so shy, and keep at so great a distance, that it is impossible to observe their actions.

The swimming birds that frequent our shores are also highly interesting.

The Sheldrake is a very handsome bird, belonging to this family, and very common on some of our shores,

where it builds its nest in old rabbit holes. The body of this bird is diversified with patches of chestnut, white, and black; its bill is bright red, its head is glossy green, and its legs are flesh coloured. The Scoter is another familiar bird on some of our coasts, but it differs much from the sheldrake, being uniformly black in its plumage, but like the former it frequents the sea-shore, often in considerable numbers, when it seeks its food, which consists of small molluscous animals.

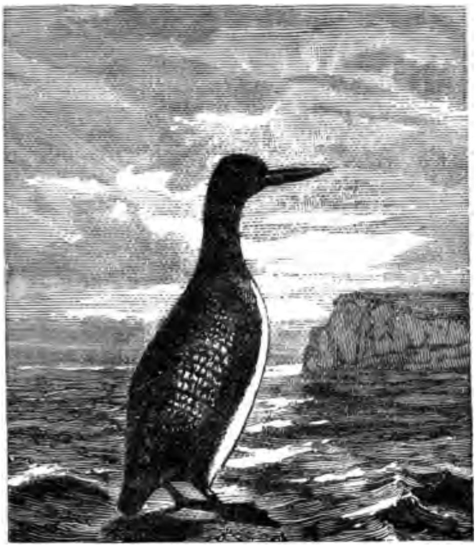
Besides these, there are the tribe of Mergansers, of which there are four species known on our shores.

Of these the Smew is the smallest, as well as the most common. Its colour is white, diversified with black and grey, the bill is slate-coloured, the face is black, and the head, neck, and breast, white; on the head is a crest of feathers, partly greenish-black and partly white. Another and larger species is the Red-breasted Merganser. The head and throat of this bird are green, the lower part of the neck and the breast are chestnut colour, and the body and wings are diversified with white, black, and brown. The largest species is the Goosander, which in its colours bears a considerable resemblance to the last-mentioned species.

The divers and the grebes have also their representatives at various parts of our shores.

These are all easily distinguished from the tribes of aquatic birds above referred to, by the long conical bill, and by the position of the legs, which are placed so far back, that when on the land these birds appear to stand upright.

The divers are very common on almost every part of our coast, and, may be readily distinguished by the expertness with which they carry on their piscatory labours, diving incessantly after their finny prey. The Great Northern Diver is a very handsome bird. The



GREAT NORTHERN DIVER.

upper part of the body is dark mottled with white, the head and neck are black tinted with green, and have two rings of mottled feathers; the under surface is white. This bird is the largest of the tribe to which it belongs, and visits our shores during the winter months,

returning during the breeding season, like the gulls, to some remote and little frequented inland lake, on whose borders it rears its young.

Another family of maritime birds comprehends the guillemots, auks, razor-bills, and puffins, all of which are gregarious, inhabiting the rocky headlands and islets,

TERN AND PUFFIN.

especially on our northern coasts, in immense multitudes.

In those inaccessible places these birds congregate at the breeding season, each of them producing a single egg, which some of them place upon the bare rock, and hatch by sitting upon it in their singular erect posture

during the requisite period. Such is the fidelity with which these birds, especially the guillemots, devote themselves to the all-important duty of incubation, that they will suffer themselves to be seized rather than quit their post.

The puffin, however, a round little bird, with black and white plumage, and a parrot-shaped bill, ribbed with orange, lays its single egg in a burrow which it digs with its bill, if it is unable to discover one already made by a rabbit, and there for a month it sits with the utmost patience, till the young puffin at length breaks the shell.

An illustration of the beautiful adaptation of the structure of all these birds to their instincts and their habits, is furnished by the structure of the gannet, or solan goose.

This bird is very abundant on our northern shores, and has various favourite breeding places in the inaccessible precipices both on the eastern and western coasts of Scotland.

In seeking its appropriate food the gannet flies at no great distance from the surface of the water, but on perceiving a fish it immediately rises into the air, and descends with extraordinary force upon its prey, sometimes by the mere impulse of its descent penetrating the waters to a depth of twenty or even thirty fathoms. Incredible as this may appear, it is certain that these birds have occasionally been found in great numbers entangled in the fishing nets sunk in the sea to the depths now stated, having darted into the water in pursuit of fish.

This power of penetrating to so great a depth beneath the surface is rendered all the more marvellous when the extreme buoyancy and lightness of the bird are considered. The gannet floats very high in the water, differing in this respect from some aquatic birds, whose bodies when they are swimming are almost wholly

GANNET AND YOUNG.

immersed, so that only the neck and head seem to be raised above the surface.

The cause of the extreme lightness of the gannet's body has been ascertained by anatomists. It appears that a system of air cells exists both along the sides and the inferior part of the body, and that these all communicate with each other, and can be completely inflated at the will of the bird. It also appears that there exists an air

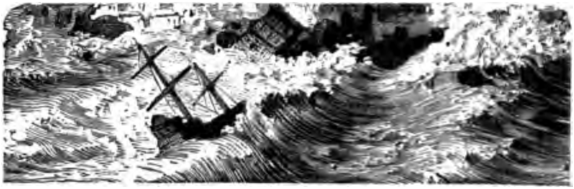
cell in the front of the breast four inches in diameter, in direct communication with the lungs, which the bird can inflate in an instant. Over all these air vessels, however, a system of muscles are stretched, by means of which the gannet can in a moment press upon the vessels, and completely expel the air they contain.

When afloat, therefore, or when flying aloft, the gannet inflates all these air-vessels. The specific gravity of its body is thus reduced, and it swims high on the wave, or soars with comparative facility in the air.

On perceiving its prey, however, and darting down upon it, the air-vessels are immediately compressed, the size of the bird becomes greatly reduced, its weight and specific gravity are increased, and these circumstances, united with the velocity of its fall, enable it to sink deep beneath the wave and secure its prey, an act which would have been physically impossible if the bird still retained its former buoyancy.

Having captured the fish, the gannet again comes to the surface, instantaneously inflates its air-vessels, and soars away with the captured prey with a degree of facility which, had it still maintained its increased density, would have been unattainable.

# THE FORCES OF THE DEEP.



# THE FORCES OF THE DEEP.

## CHAPTER I.

### SALTNESS AND CIRCULATION.

THE saltness of the sea! What fact is more trite, yet what fact is less understood?

What the sun is to the vapours of the sky, lifting them from the watery deep and conveying them to the thirsty land, what the heart is to the body, pumping the freshened blood through all the vitalising channels of the limbs, that saltness is to the sea.

It is the saltness of the deep which sets in motion its mighty currents, creates between sea and sea a grand system of circulation, and gives to its vast and varied regions a resemblance to organic beings, uniting part and part, as limb and limb in the human frame.

If then the currents of the ocean are its system of circulation, the great arteries and veins through which its

constitution is kept in healthful being, saltness may be said to be the propelling force, the beating heart.

True, the saltness of the ocean is not the only cause of currents; for the difference of temperature in its waters produces currents, just as differences of the same kind in the atmosphere produce winds; yet there is reason to believe that the saltness of the sea materially aids those currents, and thus ministers to a vast and most important part of the economy of creation.

This fact is easily explained.

In the process of evaporation the vapour of water which is taken up into the air is pure, for the salts of the sea-water are not raised into the atmosphere. Now by the abstraction of the watery particles, the surface-water is rendered salter, and therefore heavier, than the stratum of water immediately below it. It therefore sinks downward and gives place to a layer of water lighter and less salt, on which in its turn the process of evaporation acts, and which again sinks only to give place to another supply.

Thus, in perpetual succession, different layers of surface-water are subjected to the same process, each sinking down afterwards by reason of its increased specific gravity.

In the Red Sea and the Mediterranean, the waters at a great depth are considerably heavier than those at the surface, and by a familiar physical law flow outwards by their own weight in an under-current, while their place is supplied by a surface-current, which, as already stated, flows inward from the ocean.

Now in fresh water this system of currents could not occur, because evaporation from the surface of fresh water does not make any change in the specific gravity of the water subjected to the immediate action of the process.

The cause, thus explained as regards the two inland seas above referred to, is also greatly concerned in the much vaster system of circulation which takes place in the ocean itself; as, for instance, in the under-current of salter and heavier water that flows from the equator toward the poles, and the surface-current of water, lighter and less salt, that flows in a contrary direction.

The proportion of salt in the waters of the deep varies in different regions according to the degree to which they are subject to the evaporating power of the sun. In the Red Sea forty-three parts out of every thousand are salt, while the Baltic Sea has, generally speaking, only five parts out of every thousand.

But, assuming the sea to be an average of three miles deep, and taking the average proportion of salt which its waters contain, and it follows that, were the deep to evaporate and its beds become dry, a deposit of salt would remain covering its entire floor to a depth of two hundred and thirty feet.

Or, put the fact in another form, there would remain one thousand million cubic miles of solid salt.

Careful calculation has ascertained that if the salt left behind by the waters evaporating into the air, and carried away from the region in which they rise by the

north-east trade wind alone for simply one year, could be collected together, they would suffice to cover the whole British Islands to a depth of fourteen feet.

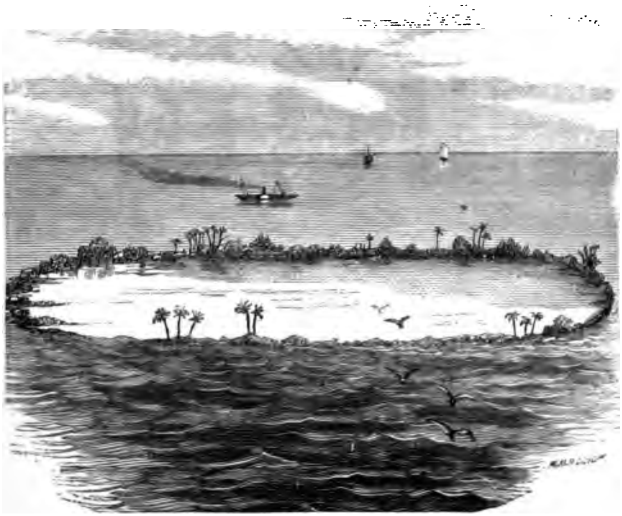
One of the constituent parts of sea-water is a solution of lime. The river or brook to which the visitant of the sea-shore approaches, as he wanders along the beach, is perpetually engaged, especially if it flows through a country in which limestone abounds, in carrying away to the sea solutions of that substance. These solutions are poured into the channel of the rivers by the rain which percolates through the soil, and dissolves part of the lime it meets with in its course. The solutions which the river thus carries along in its waters are too delicate to be discovered by the sense of taste; nevertheless the aggregate quantity of lime thus poured into the ocean from all the rivers of the earth must be vast.

Now it is from this lime so dissolved and mingled with the sea-water, that in some parts of the ocean, as for instance the Pacific, the prodigious coral reefs are constructed.

These reefs form under the waters a solid mountain of stone often of immense extent. On the coast of New Holland there is one coral reef a thousand miles in extent, and unbroken for a distance of three hundred and fifty miles. In the Pacific there are groups of twelve hundred miles in extent by more than three hundred in breadth.

All these vast structures are the work of countless myriads of coral-building polypes (*Madrephylliæa*), and

afford one of the many proofs how vast a work may, in the complicated processes of divine providence, be executed by a feeble instrumentality. A little worm which could in a moment be crushed by the finger, and is individually the very type of weakness, can by the

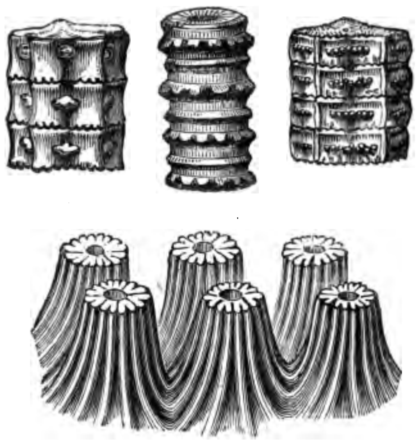


ISLAND FORMED BY THE CORAL BUILDERS.

multiplication of its numbers, construct a mountain on which the fiercest billows of the ocean spend their fury in vain; on whose shores the proudest ship that ever illustrated human genius may be broken to fragments, and on whose surface plains full of beauty and verdure

may appear, and towns and villages, the habitation of man, be erected.

And how marvellous the thought thus suggested to us! By this means the component parts of the limestone rocks of countries far removed from the sea may be gradually carried thither, and then transported by oceanic currents may be formed into new mountains at the



MARINE DWELLINGS FORMED OUT OF SEA-LIME.

bottom of remote seas, thus giving origin to new countries which in some future geological convulsion may be raised into lands far above the sea level, on whose mountains rains shall fall, and through whose valleys rivers shall flow, again to repeat the process by which the limestone which formed its rocks found its way to the original coral-builders.

And what relation has the coral-building polype to the circulation of the sea? What place does this tiny creature occupy amongst the forces of the deep?

Let us consider this question.

Out of the sea-water this little creature has the power—a power in itself marvellous—of extracting the lime necessary to the building it is to erect. It secretes this substance, no doubt, for its own individual use; but in so doing it is accomplishing a grand design of Him who originated the economy of the globe we inhabit. It cannot be doubted that the secretion of lime from the sea-water by the act of myriads of polypes at the same instant, must lessen the specific gravity of the water with which they are in contact, and from which they extract one of its constituent parts.

Whatever the actual weight of the lime thus secreted may be,—and it may, in the construction of one reef alone, amount to thousands of pounds in a day,—that weight is so much abstracted from the water, which, being thus lighter than the strata of water over it, rises upwards to the surface, and is replaced by water heavier, salter, and charged with the lime required by the little reef builder for the work which he could not carry on if the water he had deprived of its lime remained around him without being replaced by a new supply.

Thus the marine insect has a very important office to perform in the circulation of the ocean waters.

But new aspects of the forces of the deep present themselves!

The waters which on becoming heavier, because rendered salter by evaporation, sink downward, are likewise warmer than those which ascend to supply their place. Thus the circulation of the sea modifies first and directly its own temperature, and secondly and indirectly the temperature of the climates of the lands it washes.

This effect is produced on a great scale in some parts of the globe; and an illustration of it is presented by our own shores.

The western shores of the British Islands, and especially the western shores of Ireland and the north-western shores of Scotland, possess a climate greatly milder and moister than the eastern coasts, and it is not to be doubted that this difference is occasioned by the current of the Gulf Stream, which, touching our western shores, imparts to the climate the mildness of its character by diffusing a portion of the caloric brought from warmer latitudes. It is for this reason, for example, that the western shores of Sutherlandshire, although so much farther north than other parts of Scotland, possess a climate so soft and genial, and exhibit such early and luxuriant vegetation; and it is for the same reason that the climate of the Orkney and Shetland islands approaches so nearly to that of Torquay.

# THE FORCES OF THE DEEP.

## CHAPTER II.

### TIDES.

THE Roman soldiers, when they first made their way to the shores of the Atlantic, are said to have been filled with astonishment at the regular and periodical ebbing and flowing of the ocean,—a phenomenon unknown to them on the lovely shores of Italy. And but for our familiarity with it, we ourselves should experience the same astonishment on first perceiving so striking a phenomenon.

That the ebbing and flowing of the tides depend on solar and lunar influences there can be no doubt. At every return of new and full moon we have high tides, while at half moon the tides are low.

The moon is in a line with the sun both when about to appear as new moon, and when at full moon. At those

periods, therefore, the attraction of the moon and the sun upon the earth acts in one and the same direction, and the united influence causes what are called the spring tides.

On the other hand, when the moon has completed her first quarter, and her third quarter, her attractive power at those points in her course is exercised at right angles to that of the sun, and thus by preventing the waters from rising as high as before, the neap or lower tides take place. Nothing can be more obvious, therefore, than the effect of solar or lunar attraction on the phenomena of the tides.

But not only does the motion of the earth in its annual orbit, and that of the moon in her monthly course round the earth, produce an alternately diminishing and increasing influence on the tides, the diurnal revolution of the earth itself exercises a remarkable power.

In its daily revolution from west to east it brings every successive hour one meridian after another vertically under the moon, so that the point at which the greatest attractive power of the moon is felt upon the earth, and which is vertically beneath the moon, changes hour after hour as different portions of her surface are presented to the action of her attendant satellite.

As the moon therefore moves from east to west, or, to speak more correctly, as the earth revolves in the opposite direction, the waters of the ocean, instead of accumulating in one place, form a tidal wave which follows the course of the moon. This wave, as it moves along the ocean, pro-

duces high water on the coasts it visits in its flow; but its force, direction, and height are more or less modified by circumstances. The broader and deeper the channel, the greater the speed of the tide, and thus the tide-wave traverses thousands of miles of the open ocean in the same space of time it requires to pass through a narrow and shallow channel of comparatively very limited extent.

Without entering into minute details it will be sufficient,

LOW-TIDE—THE SHORE.

in order to illustrate the direction and the rate of progress of the tide, briefly to refer to that which occurs in the Indian or the Atlantic oceans.

From the south of New Zealand the tide-wave advances westwards and northwards towards the Cape of Good Hope, at which it arrives in thirteen hours from Van Diemen's Land, at the same time producing high water

also along the east coast of Africa, the southern shores of India, and the Islands of the Eastern Archipelago.

Entering the Atlantic, and moving to the north-west, the wave of high water arrives on the coast of Newfoundland in twelve hours after leaving the Cape of Good Hope. In four hours afterwards it reaches the mouth of the British Channel, where, owing to the nature of the various shores, it is subdivided in its course. One

HIGH-TIDE—THE HARBOUR.

portion passes through the Straits of Dover, another flows up St. George's Channel, a third portion of it passes northwards along the west coasts of Ireland and Scotland, around the Orkneys, and thence southwards till it meets the tide, which, owing to the narrowness of the British Channel, had in the meantime advanced at a comparatively slow rate to the north.

The effect of the double wave thus produced by the intervention of the British Islands, and the comparatively narrow space between England and France, is very remarkable on the Danish shores, where the ebb and flow of the sea ceases to be perceptible, and it is constantly high water.

The height to which the tide flows is various in different parts of the world, and this dissimilarity is chiefly occasioned by the conformation of the coast.

In the Mediterranean there is little or no tide, while in some parts of the American coast, as in the Bay of Fundy, the spring tide frequently rises to the extraordinary height of a hundred and fwenty feet, and in Asia, as at the mouth of the Indus, the rise of the tide is thirty feet. Even in Britain there is a great difference in the depth of high water at different places. At Chepstow, in the Bristol Channel, the rise of the tide is much higher than in many other places, being from forty-five to sixty feet, and after a strong westerly wind, it is said sometimes to reach seventy feet.

The very striking phenomenon called the Bore cannot be passed over in silence while referring to the subject of the tides.

Where an estuary is narrow, and the shore is level to a considerable distance inland, the great body of water produced by the tidal wave being suddenly forced into a confined space, rises to a proportionate height between the opposite shores, and flows onward, partly under the influence of the original impulse acting upon it, and partly by its own gravitation.

Into the Bay of Fundy, already mentioned, the "bore' rushes with tremendous force, and with a roaring noise, appearing as it ascends like a cataract pouring down a slope, in the same manner as the rapids of the St. Lawrence. This singular phenomenon takes place likewise in many of the Asiatic rivers.

In the Hoogly, or Calcutta River, "the bore," says Rennell, "commences at Hoogly Point, the place where the river first contracts itself, and is perceptible above Hoogly town; and so quick is its motion that it hardly employs four hours in travelling from one to the other, though the distance is nearly seventy miles.

"At Calcutta it sometimes occasions an instantaneous rise of six feet, and both here, and at every other part of its track, the boats on its approach immediately quit the shore, and make for safety to the middle of the river.

"In the channels between the islands at the mouth of the Megna, the height of the bore is said to exceed twelve feet, and is so terrific in its appearance, and dangerous in its consequences, that no boat will venture to pass at spring tide."

The following is an interesting and graphic account of the same phenomenon, which in China is called the "eagre," as taking place on the Chikiang River, which enters the sea about ten miles below the city of Hang-Chow.

"Between the river," says the writer, who was an eye-witness of the occurrence, "and the city walls, which are a mile distant, dense suburbs extend several miles

THE BORE AT CALCUTTA.

along the banks. As the hour of flood-tide approached, crowds gathered in the streets, running at right angles with the Tsien-tang, but at a safe distance. My position was a terrace in front of the Triwave Temple, which afforded a good view of the entire scene.

"On a sudden all traffic on the thronged mart was suspended; porters cleared the front street of every description of merchandise, boatmen ceased loading and unloading their vessels, and put out into the middle of the stream; so that a few moments sufficed to give a deserted appearance to the busiest part of one of the busiest cities of Asia. The centre of the stream was crowded with craft, from small boats to huge barges, including the gay 'flower boats.'

"Loud shouting from the fleet announced the appearance of the flood, which seemed like a glittering white cable stretched athwart the river at its mouth as far down as the eye could reach. Its noise, compared by the Chinese poets to that of thunder, speedily drowned that of the boatmen; and as it advanced with prodigious velocity, it assumed the appearance of an alabaster wall, or rather of a cataract four or five miles across, and about thirty feet high, moving bodily onward. It soon reached the immense assemblage of vessels waiting its approach.

"Knowing that the bore of the Hoogly, which scarce deserved mention in connection with the one before me, invariably overturned boats that were not skilfully managed, I could not but feel apprehensive for the lives of the floating multitude. As the foaming wall of water

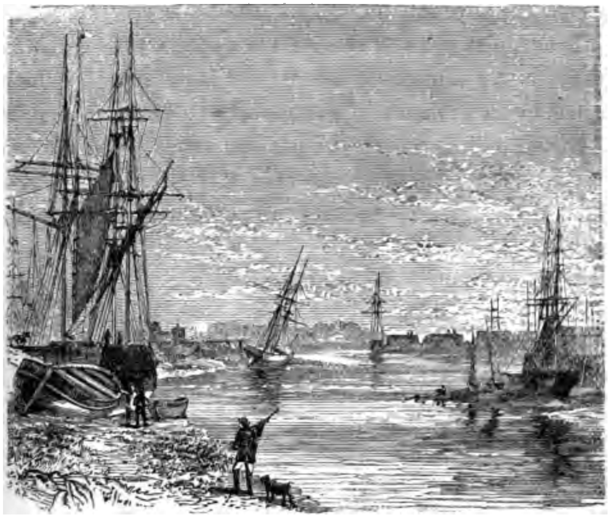
dashed impetuously forward, threatening to submerge everything afloat, they were all silenced, and intently occupied in keeping their prows toward the wave; and thus they all vaulted, as it were, to the summit in perfect safety.

HIGH-TIDE—THE RIVER.

"The spectacle was of the greatest interest when the eagre had passed about half-way among the craft. The boats in front were quietly reposing on the unruffled surface of the stream, others were scaling with the agility of salmon the formidable cascade, while those

behind were pitching and heaving in tumultuous confusion on the troubled water.

"This grand and exciting scene was but of a few moments' duration; it passed up the river in an instant, but with gradually diminishing force, size, and velocity



LOW-TIDE—THE RIVER.

until at about eighty miles above the city, according to the Chinese accounts, it ceases altogether to be perceptible."

On our own shores the remarkable phenomenon may be witnessed in more than one instance.

In the estuary of the Severn, where the spring tide

rush upwards with extraordinary rapidity, the bore is sometimes nine feet in height. A similar instance occurs in the Solway Firth, where the tidal wave flows into the channel with such velocity that it is said that at a certain part of it, if a man on a swift horse were at the water's edge, the utmost efforts of his steed would be insufficient to enable him to gain the land.

The regular ebb and flow of the ocean waters produce many vastly important effects, although many of their effects in the economy of nature may be of much higher importance than we are at present aware. Even if we restrict our view of their beneficial results to those which refer to navigation, we may perceive how considerable they are.

There are numerous rivers on our coasts, the bars at the entrance of which would be impassable unless during a rise of tide, and many places now used as harbours could not be so employed were the water to remain at a low level. The currents, moreover, produced by the flow and the recess of the tides, are of no small importance to the navigation of estuaries, giving motion to ships when there is no wind.

# THE FORCES OF THE DEEP.

## CHAPTER III.

### CURRENTS AND WINDS.

THE currents of the ocean differ entirely from the tides, not only in being permanent phenomena, but as arising from causes altogether different.

There are currents which run from the Atlantic into the Mediterranean, and from the Indian Ocean into the Red Sea; and on the principles laid down with great ingenuity by Lieutenant Maury, it may be considered as fully demonstrated that under-currents proceed from those two inland seas outward to the oceans with which they are connected, carrying with them the waters which by the process of evaporation have become salter, and therefore heavier, than those of the ocean.

Were this process not to be carried on, the depths of the Mediterranean and the Red Sea would, in process

of time, become filled up by deposits of solid crystals of marine salts.

The Indian and the Pacific Oceans have their currents arising from several causes and variously modified, but all obviously subject to physical laws which give regularity to their phenomena, and minister to the great system of circulation in the waters of the ocean.

To the influence of strong currents, bent from their course and confined in a favourable spot, is owing that remarkable phenomenon, the whirlpool known as the Maelstrom, off the coast of Norway. An American captain who had navigated his ship perilously near to it, says:—

"The moment we entered the dish of the whirlpool the velocity of the water altered her course three points towards the centre, although she was going eight an hour through the water. This alarmed me extremely for a moment; I thought destruction inevitable. The vessel, however, answered her helm directly, and we ran along the edge, waves sweeping round us in every form. The sensations I experienced are impossible to describe. Imagine an immense circle of a mile diameter revolving round and round in upon its own centre, and there sinking into fathomless depths, the velocity of the revolution increasing as the course nears to their fatal vortex, swirling, foaming, rushing, in wild confusion; its level depressed towards its middle very much as the water in a funnel when half run out; the noise, too, hissing, roaring, dashing, dark on its outer edge, whiten-

ing to froth-white at its middle. Imagine the sight of this all pressing on the mind at once. It was the most awfully grand and solemn sight I ever witnessed."

Vessels which are caught in its force become its helpless toys until they are its hopeless wrecks; even whales are sucked into it and dashed to pieces.

For a long time evil spirits were supposed to be the cause of this purely natural phenomenon.

But the most remarkable of all the ocean currents is the Gulf-stream.

This vast flow of waters is more rapid in its course than the Amazon or the Mississippi, and a thousand times greater in its volume than either of these majestic rivers. The Gulf-stream may truly be called one of the most marvellous things in the natural history of the sea. It has its birth in the Mexican Gulf, from which it flows along the shore towards the British Islands, the North Sea, and the Frozen Ocean.

Our knowledge of the various causes in which this vast current originates, and by which it is modified, is in many respects indefinite, but, according to the views of Maury, two of the principal agents concerned in producing the phenomenon are,—

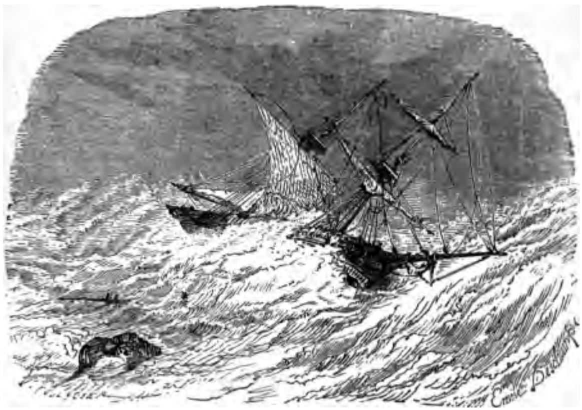
The increased saltness of its waters, caused by the evaporation necessary to supply the trade-winds with vapour, and,

The diminished quantity of salt in the northern seas, towards which the Gulf-stream flows.

Winds are not less forces of the deep than they are currents of atmosphere.

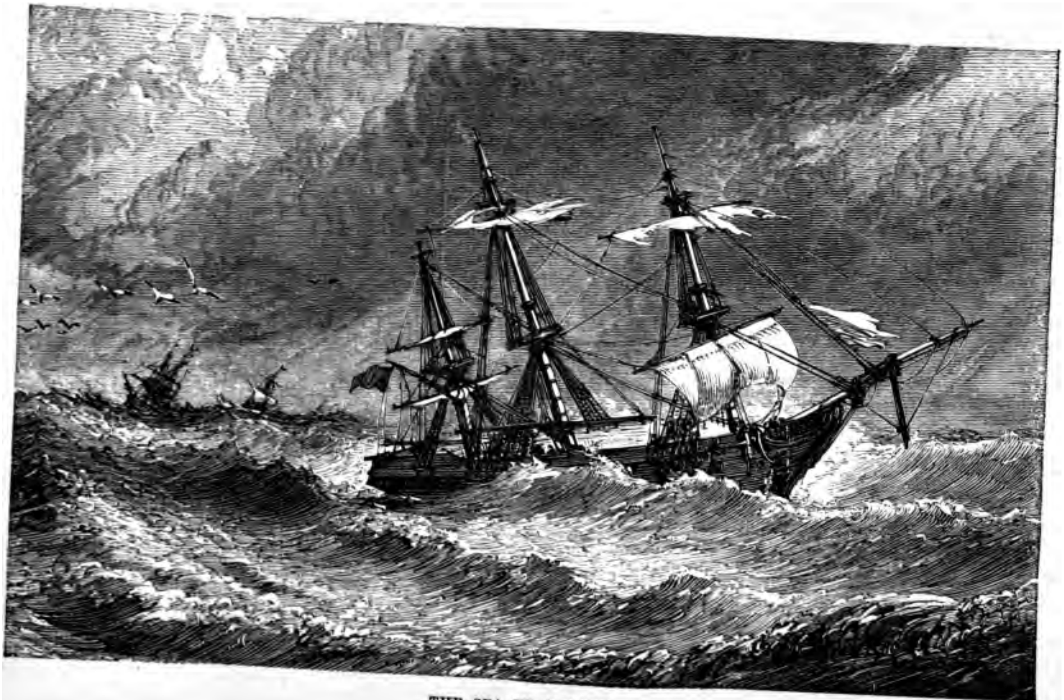
The effects wrought by wind upon the sea's surface, from its lustrous ripple to its mightiest waves, are amongst its most striking and awful phenomena.

The height of waves varies greatly, according to whether



THE SEA IN A HURRICANE.

the wind is a breeze, a gale, or a hurricane. In the North Atlantic they have been known to reach a height of forty to forty-five feet, measuring at their base six hundred to six hundred and fifty feet. At the meeting of the Indian and Atlantic Oceans off the Cape of Good Hope they attain the height of from fifty to sixty feet, with a



THE SEA IN A GALE.

width at their base of seven hundred to eight hundred feet, and it is said that in this region they have been seen having a height of upwards of a hundred feet.

The winds are either—

Constant, or such as blow always in the same direction;

Periodical, or such as blow six months in one direction and six months in another; or,

Variable, that is to say, such as do not appear to be subject to any general rule.

All winds or aërial currents may be said to be caused by something which acts either continuously or at intervals in disturbing the equilibrium of the atmosphere.

Of this the tropical winds afford the most remarkable instances.

The trade-winds of the Atlantic are occasioned by the heat of the sun, which, rarefying the air over the African continent, causes it to rise upwards, when its place is immediately supplied by currents of colder air blowing from the north and south. In the Indian Ocean, likewise, a similar phenomenon takes place; the air over the vast plains of tropical India becomes heated, and a current blowing from the south to occupy the place of the heated atmosphere causes the periodical winds known as the monsoons.

The sea and land breezes which occur during the morning and night in the tropics originate in a similar cause. The sun heats the land, and consequently the air over its surface, which ascending causes a breeze from the

cooler atmosphere over the ocean to blow towards the land; but at night, when the land and the air over it have cooled down after sunset, the wind blows from shore to supply the place of the warmer air which then ascends from the surface of the sea.

FISHING-BOAT IN A SQUALL.

The winds which prevail on the coasts of Britain are extremely variable, and can hardly be reduced to anything like system. But there can be no doubt that they are occasioned by heat and electricity, agents which produce rapid alterations in the equilibrium of the atmosphere.

The land and sea breezes already referred to may be frequently perceived on the shores of Britain during the fine weather of summer, and are produced by the same causes which operate on tropical coasts.

The westerly winds which blow upon our shores are much more regular and continuous than any others, and are, as is well known, greatly more genial and healthful.

Their causes are similar to those already adverted to.

The heated air over tropical lands rises upwards, as already described, and while its place is taken by cooler currents blowing towards the equator, the warmer air ascending to a great height in the atmosphere spreads itself to the north and south, and as it parts with its superabundant caloric falls again towards the earth, blowing towards our western coasts laden with much of the warmth of tropical lands, and with an abundant supply of oxygen obtained from the luxuriant vegetation of the more favoured climates from which it originally arose.

Thus the ocean and the atmosphere both have their systems of circulation, and those systems produce effects of vast importance in the economy of nature, conducing in a marvellous degree to the vitality and the enjoyment of animated beings. To their continual operation we may attribute not only those fresh and salubrious breezes which contribute so much to the health and vigour of the inhabitants of our coasts, but those rains which fall upon the land, supplying our innumerable brooks, rivers, and lakes; and clothing our hills, plains, and valleys with luxuriant verdure.

# THE INHABITANTS OF THE DEEP.

## PART I.

## AMPHIBIA.

# THE INHABITANTS OF THE DEEP.

## PART I.—AMPHIBIA.

## CHAPTER I.

### WHALE AND DOLPHIN.

THE whale is at once the largest of the inhabitants of the deep, and the largest member of the animal kingdom. The length of an ordinary whale is about sixty feet, but occasionally they have been found not less than one hundred feet in length, and it is said by persons well able to judge, that some have been seen in the neighbourhood of the Aleutian Islands which must have measured not less than one hundred and seventy feet.

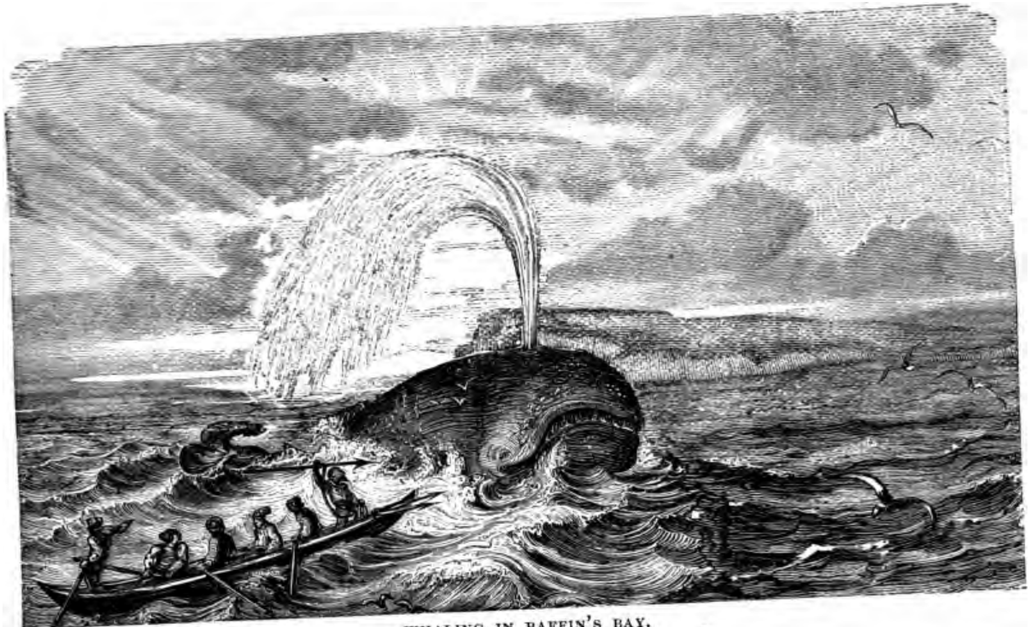
But the size of even the smallest of these monsters is gigantic. Its circumference will be nearly forty feet, and its weight not less than thirty tons. Of whales there are

three principal tribes: the Greenland, the Rorqual or razor-backed, and the Cachalot, or Sperm whale. Of these the Rorqual is the largest, and the Greenland is the most frequent visitor to the British shore.

The Greenland whale averages from forty to seventy feet in length, and from twenty to thirty feet in circumference. Its head is about one-third of its whole length, and its brow, if we may so speak, is from ten to twelve feet across. It has no fin upon its back, but it has two of enormous size upon its breast, each being about ten feet long by six feet broad. The breadth of its tail, or tail-fin, to which we shall call special attention in a later part of this chapter, is about five-and-twenty feet. The monster's mouth is not furnished with teeth, but instead with rows of fine bones, which hang from the roof of the mouth in close proximity to each other, and may be compared to rows of deep fringe. This part of the whale furnishes what is well known as whalebone. The water taken into the mouth is not ejected by gills as is the case with fishes, but through blow-holes, or nostrils. It is furnished with a thick coat of fat, called blubber, which, when a moderate size, will yield from twenty to thirty tons of oil.

No wonder that the whale should tempt ships to its native seas to capture it; for, in the English market, the oil, which it yields in such abundance, will fetch about £30 per ton, and the whalebone of its mouth from £100 to £300 per ton.

The whale is caught in small boats; each boat is



WHALING IN BAFFIN'S BAY.

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furnished with iron spears called harpoons, attached to ropes which lie in coils on the floor at the boat's bow. When the whale sea is reached by the ship to which these boats belong, they are lowered. On a whale coming up to the surface of the sea to breathe, the boats are swiftly rowed near, and on approaching the whale one of the men in the boat, called the harpooner, used to throw the harpoon into the air so as to insure its falling

HARPOONED WHALE PLUNGING.

on to the back of the whale, the weight of the harpoon and the height of its fall sinking it deeply into the body of the whale. But now the harpoon is generally fired from a gun. Smarting from his wounds, the whale plunges again into the deep. But he must soon rise to the surface to breathe. No sooner does he again appear than another fatal shaft hits him. Finally, faint with the loss of blood,

he rises to the surface without power to plunge again, and his huge fat body floats. Now the ship comes near, and the dead monster is craned on deck.

The occupation of the whaler is as perilous as it is lucrative. With a stroke of his colossal tail the wounded whale can overturn or shatter into a thousand fragments his hunters' boats. A glimpse of the kind of danger to which the whaler is exposed is afforded by the following well-authenticated incident, which occurred in the attempt to catch one of the rorqual tribe :—

"A whale was seen swimming about between the ship and an ice-field. The boats were lowered, in hope of capturing him. The leading boat dashed on. The harpooner stood up with his weapon in hand. The whale awaited their approach, floating on the surface.

"At length the boats were up to him. The harpoon was plunged deep into his side. As the line ran rapidly out the monster darted forward. The boat, held fast by the line, followed. The water hissed, and dense clouds of spray flew over her bows.

"On, on they dashed, and almost before they are aware of it, they were on the edge of the ice.

"With the speed of lightning the whale plunged beneath the wide-extending sheet of ice, and in another instant, almost before the crew can utter a despairing cry, downward the boat was drawn; and those who watched her at a distance with horror saw her and all on board disappear! They rowed up to the spot, but not a trace could be found of either the boat or of its unfortunate crew."

The class of animals to which the whale belongs occupies the highest rank in the animal kingdom. It is known as the *Mammalia*—from the Latin word *mamma*, a teat. Both whales and seals are warm-blooded creatures, who suckle their young like cows, instead of laying eggs, like birds and fish.

Though not common on the British shore, the whale and the order to which the whale belongs, are more or less known in our seas.

The Dolphin is one of these; but it is only occasionally met with on British shores; its home being the Mediterranean Sea and the Indian Ocean.

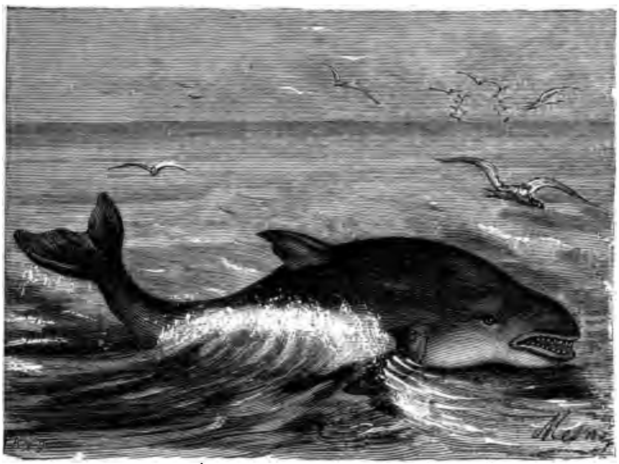
The dolphin tribe includes the dolphin proper, the grampus, the narwhal, and the porpoise.

The grampus is twenty or twenty-five feet long, it inhabits northern seas, and is remarkable for its fierceness and power. It makes war on porpoises, dolphins, whales, and if irritated will attack ships with most injurious effects.

"Of the monsters of the deep," says Lieutenant Drayson, "the grampus was the first creature of which we had a close view. This happened when our vessel was near the Canary Islands. The day was clear and sunny, as it usually is in those latitudes, and little more than a ripple was on the sea. The vessel, running about eight knots per hour, glided smoothly through the waters, her lower studding sail boom, gracefully dipping now and again, and just lifting the spray from the pigmy waves.

"'Look! look!' was the exclamation of the mate, as he

pointed at the sea a few yards astern; and on looking we there beheld a monster, about twenty feet in length, of a brown colour, with a snub nose and broad back. It came on with speed, though there was no sign of the means by which it propelled itself; in an instant it was alongside, and we looked directly down on the creature, which rose

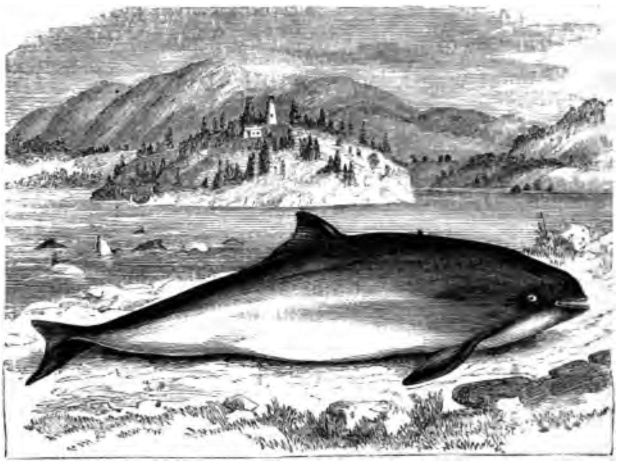


GRAMPUS.

and fell in the water as does a boat over the waves, or a finch in its aërial flight. On the head was a large hole, through which the creature puffed and blew, so that we have ever since appreciated the trite expression of 'blowing like a grampus.'

"The first idea of those who possessed a sporting

tendency on board was to seize a harpoon and bury it in the body of the grampus. The captain, however, was more cautious, and anticipated dangerous consequences, for he believed that, as the monster fish was at the time rubbing itself against the vessel's sides, it would, when wounded, damage the ship by the lashing of its powerful



PORPOISE.

tail. Thus he stayed the uplifted hand of the harpooner, and we contemplated the strange creature that had thus fraternised with the ship, and was within arm's reach of us, until getting tired of our society, it turned off and disappeared from view."

The Narwhal or Sea-unicorn, which is remarkable for

having a spirally twisted tusk projecting from its snout, five, seven, and even ten feet in length, sometimes finds its way to our shores from the dreary regions of the North Sea, where it habitually resides.

There are many considerations of the greatest interest connected with the natural history of all these animals.

In the first place, there is a remarkable peculiarity in the structure of the tail, which distinguishes whales and all the order from fishes properly so called. The tail of the fish is vertical in its direction, while that of the whale family is horizontal.

The reason of this peculiarity becomes obvious at once if we consider that all the whale tribe breathe by means of lungs in the same manner as quadrupeds. They require, therefore, to have direct access to the atmosphere, and although living in the sea, and capable of remaining submerged for a considerable length of time, must at certain intervals visit the surface in order to breathe. Now the horizontal position of the tail is, of all others, the best suited to this purpose.

There is a striking peculiarity, too, in the structure of the mouth of the common whale.

This animal feeds upon the minute crustaceous and molluscous animals, and the gelatinous medusa that abound in the northern seas. Its jaws are accordingly furnished, not with teeth, but with a series of horny laminæ, called whalebone, or baleen. These plates are attached to the upper jaw in rows parallel to each other,

and are furnished at their edges with fringes to the number of several hundreds. These fringes form a strainer through which the water, taken into the animal's mouth, is made to pass, leaving behind multitudes of the creatures which form its food.

To an animal thus nourished, teeth would not constitute a suitable apparatus; but the huge strainer in question is precisely adapted to the whale's requirements, its food needing no mastication.

There is still another peculiarity in the structure of the whale.

What is called the blubber has been ascertained by anatomists to be the true skin of the whale. This skin consists of a mass of fibres interlacing each other, as in ordinary skin; but the texture is much more loose and open, and thus affords room for the fatty matter, or oil, deposited in it, and varying in thickness from that of several inches to between one and two feet. The skin, thus thickened, is adapted in such a manner to the requirements of the animal as to excite the utmost admiration.

The skin is, as already stated, not only open in its texture and of great thickness, but it is filled with a substance the specific gravity of which is considerably less than that of sea water. This substance envelops the whole body of the animal, and serves the important purpose of rendering buoyant a fabric so huge, of which even the bones are of very great weight compared with those of fishes.

But the skin, so peculiar in its structure, performs another most excellent office.

It is an extremely bad conductor of heat, inasmuch as there is no circulation among the particles of which the deposited oil is composed. Hence the animal heat of these warm-blooded animals is not transferred to the surrounding waters, nor can the external cold penetrate them. By this means the whale can with perfect safety inhabit the coldest water.

This arrangement of its skin is necessary to its existence, because of its being a warm-blooded animal; if, on the other hand, the whale possessed cold blood, like a fish, such a protection would have been unnecessary.

But the skin in question strikingly answers a third purpose.

It is extremely elastic, and it is well known that elastic substances, and even air itself, which possesses great elasticity, present an increasing resistance with every increase of pressure. Thus the more elastic the substance, the more does its reaction equal the compressing power to which it is exposed.

Now the whale is wont to descend to an immense depth in the ocean, and this would expose it to destruction, were it not for the resistance which the structure of the skin presents to the enormous compression of the surrounding water. At a great depth below the surface every square inch of the animal's body may be pressed upon with a ton weight, making an aggregate compressing force of many thousands of tons.

# THE INHABITANTS OF THE DEEP.

## CHAPTER II.

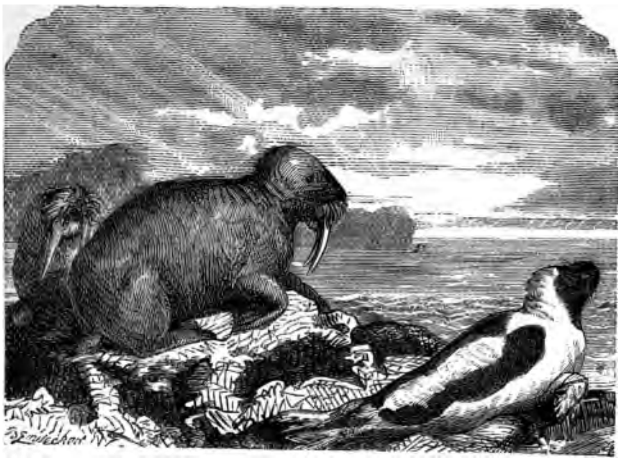
### WALRUS AND SEAL.

THE common seal needs only to be seen to attract and fascinate attention, as visitors to the magnificent aquaria of Brighton or Southport are fortunately able for themselves to prove. It belongs to the tribe which, though marine animals, are not fishes. They breathe air and cannot live without it. Seals are divided into two classes :—the walrus and the seal proper.

The walrus sometimes attains the length of twenty feet. Its mouth is furnished with two tusks, which grow from its upper jaw and are sometimes two feet in length.

Of seals proper there are several varieties, some being known as the sea-cow, the sea-horse, the sea-lion, all being alike in their general form. They have beautiful and intelligent eyes, small dog-like head. They lack

visible ears, instead of which they possess valve orifices which, in air, they open, and in water shut. They have limbs between feet and fins, which serve them to wriggle about on land and to swim in the sea; and they are covered with short glossy fur which, unfortunately



WALRUS AND HARP SEAL.

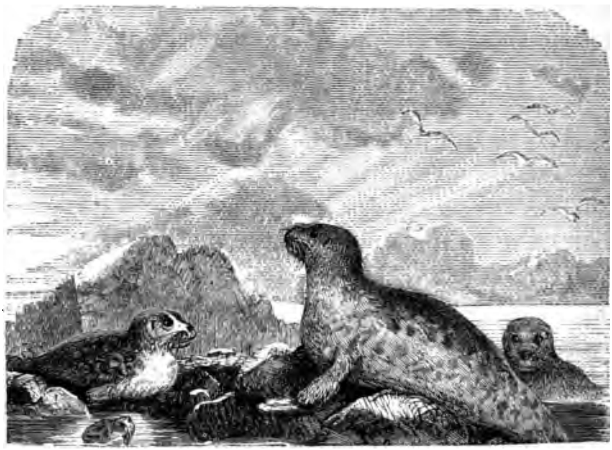
for their own peace and safety, excites the envy of the lady world and attracts the hunter to their sea.

Seals live in herds and are to be found in many parts of the globe, and to our own shores they occasionally wander, but in cold north regions they are most numerous.

Although water is its chief abode, the seal haunts

caverns and recesses among the rocks, in which it brings forth its young, which are generally two in number, and are nursed by their mother with great assiduity and tenderness.

The favourite food of this animal when inhabiting coasts at a distance from rivers consists of almost any of



COMMON AND MARBLED SEAL.

the larger kinds of fish, and it is said especially flat fish; but when it frequents the estuaries of our larger rivers it makes terrible havoc among the salmon, which it often pursues even into the nets of the fishermen.

Although all seals possess attractions to the admirer of nature, it is to the common seal belong the charac-

teristics which excite the interest, if not, indeed, the affection, of those who enjoy its intimate acquaintance. It is remarkably intelligent and docile. It is capable of being tamed, and it evinces great affection for its master. But one of the most remarkable of its peculiarities is its marvellous fondness for music. Laing mentions, in his "Account of a Voyage to Spitzbergen," that the tones of his violin would generally draw around him an audience of seals, who would follow his boat for miles.

In the "Naturalists' Library" the following statement is made by an excellent writer: "The fondness of these animals for musical sounds is a curious peculiarity of their nature, and has been to me often a subject of interest and amusement. During a residence of some years in one of the Hebrides I had many opportunities of witnessing this peculiarity, and, in fact, could call forth its manifestation at pleasure.

"In walking along the shore in the calm of a summer afternoon, a few notes of my flute would bring half a score of them to within twenty or thirty yards of me; and there they would swim about with their heads above water like so many black dogs, evidently delighted with the sounds. For half an hour, or indeed for any length of time I chose, I could fix them to the spot; and when I moved along the water's edge they would follow me with eagerness, like the dolphins, who, it is said, attended Arion.

"I have frequently witnessed the same effect when out

on a boat excursion. The sound of a flute, or of a common fife, blown by one of the boatmen, was no sooner heard than half a dozen would start up within a few yards, wheeling round us as long as the music played."

Another author mentions the remarkable fact that when the bells of the church of Hoy, which stands on the sea-shore, were rung for divine service, all the seals within hearing made directly for the shore, where they kept looking about them as if surprised at the sounds.

This peculiarity in the seal has often been regarded as fabulous, but there is no reason whatever to doubt its accuracy.

The element in which the seal chiefly dwells is the sea, and although on land its movements are awkward in the extreme, no aquatic animal is more admirably adapted to move in the water. If we examine its structure we perceive that its trunk bears no inconsiderable resemblance in its general figure to the body of a fish. It is elongated and conical, tapering from the chest to the tail; the hinder limbs are directed backwards so as to terminate the body, and consist of broad webbed and powerful paddles; the whole structure of the body combined with the animal's great muscular power adapting it, like a fish, to make its way with extraordinary ease and rapidity through the element in which it chiefly lives, and to seize upon its finny prey, notwithstanding the swiftness of their movements.

The structure of this creature's body exhibits several

other most striking instances of adaptation, one or two of which we cannot refrain from pointing out.

Water is the principal element in which the seal has its abode, and in order to capture its prey it is frequently necessary for the animal to remain immersed for a considerable length of time. Its respiration accordingly

SEAL-FISHING IN NORTHERN SEAS.

corresponds with this necessity, differing materially from what is observed in most other animals. It is able to remain at least twenty minutes under water, during which time the nostrils are closed, so that during its immersion no water can enter the air passages.

Even when on land the period intervening between the

inspirations has been found to be of great length, two minutes often occurring between each breath; but the great quantity of air taken in upon each breath makes up for the small number of the animal's respirations.

But not only its respiration, and even its nostrils, are accurately adapted to its subaqueous habits, but the eye itself is so accommodated. It is specially adapted for seeing in the water, and as the seal is often at great depths exposed to unusual pressure, a provision for the protection of the eye is made by an appropriate mechanism, consisting of an additional eyelid, placed at the inner angle of the cornea, which at the will of the animal may be drawn over the whole eye. It appears, moreover, that even the apertures of the ears may be closed, a structure existing for this purpose, by which they are rendered impervious, however great the pressure of the surrounding fluid may be.

Can any cause be assigned for arrangements so specially adapted to the required conditions other than the design and purpose of that Being who gave to the material world its peculiar laws?

# THE INHABITANTS OF THE DEEP.

## Part II.

## FISHES.

# THE INHABITANTS OF THE DEEP.

## PART II.—FISHES.

### CHAPTER I.

#### COD, FLAT-FISH, AND HERRING.

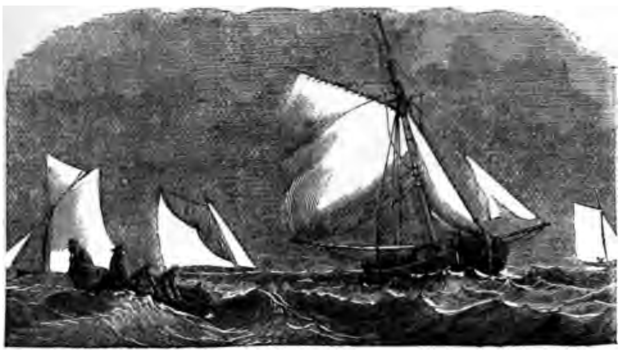
AMONG the most valuable of edible fishes are those comprehended in the cod and haddock family. The cod properly so called is a familiar type of the order to which it belongs.

These fishes are to be found on every part of the shores of Britain and Ireland, and appear to be most plentiful off the northern coasts of Scotland. They chiefly inhabit places where the water is from forty to fifty fathoms in depth.

They are extremely voracious, devouring fish of all kinds, molluscs and crustacea, crabs of considerable size

being often found in their capacious stomachs, no fewer than thirty-five crabs, none of them smaller than a half-crown piece, having been taken from one fish.

No fish is of greater utility. The flesh is white, firm, and of excellent quality, and every part of the fish is capable of being turned to some useful purposes. The tongue, either salted or fresh, is a great delicacy. The gills are employed as baits in fishing; the liver furnishes

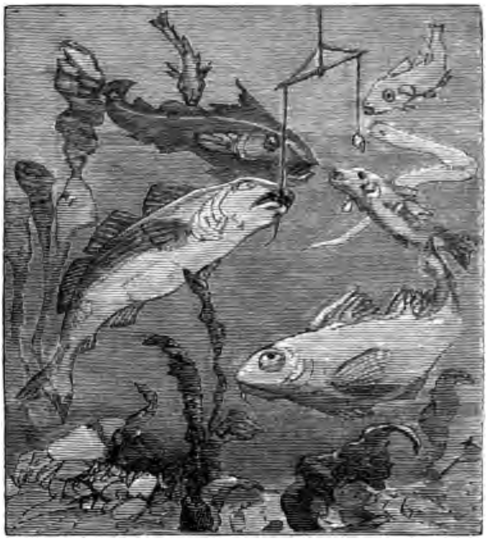


COD-FISHING.

an enormous quantity of excellent oil, applicable to a variety of useful purposes, and possessing highly nutritive qualities, and peculiarly suited as an article of nourishment to persons of feeble health; the swimming-bladder furnishes isinglass equal in quality to that yielded by the sturgeon; and even the head furnishes the fisherman and his family with food.

The Norwegians, on whose coast the cod is very

abundant, give it together with marine plants to their cows, for the purpose of producing a greater quantity of milk. In Iceland the bones afford nourishing food for cattle, and the people of Kamschatka feed their valuable dogs with it. On the desolate shores of the Icy Sea



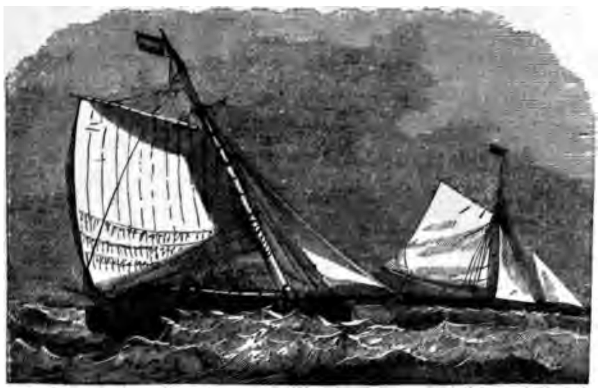
TAKING THE BAIT.

the same parts when thoroughly dried are employed as fuel.

The fecundity of the cod is amazing. Nine millions of eggs have been counted in the roe of a single fish of middling size, and if the enormous multitudes which must be

thus produced and which must survive the devastation of their enemies, be taken into consideration, along with the useful and valuable properties which this fish possesses, it is impossible not to admit that among the purposes for which it has been designed, we are entitled to reckon that of supplying many of the wants of the human race.

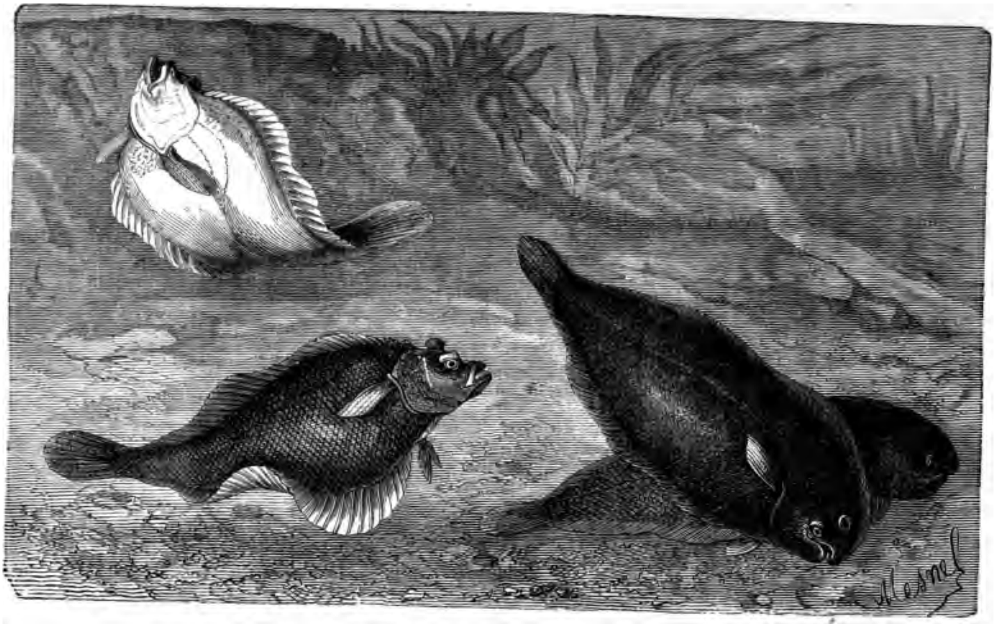
Another family of edible fishes, of which many of the



TRAWLING FOR FLAT-FISH.

various species are familiar to our readers, is what are popularly known as flat fish, and comprehend eighteen or twenty kinds, including among them the plaice, the flounder and its varieties, the halibut, the turbot, and several kinds of sole.

The characters peculiar to this race of fishes are so distinct as to render it one of the most marked and insu-




SOLES.

lated of all the families into which the finny tribes have been subdivided.

There is a singular want of symmetry in some parts of the figure of the flat fish. The head appears as if forcibly twisted to one side, in consequence of which the mouth appears distorted. The body is compressed, and almost surrounded by the dorsal and anal fins as with a fringe.

The habitation of these fishes is the bottom of the sea, and they are not furnished with the air-bladder so frequently forming part of the structure of those fishes which frequent the higher parts of the water.

Reference has already been made to the very remarkable resemblance which fishes present in their hues to that of the ground they frequent. In no instance is this more striking than in the tribe of fishes to which we now refer. While the side next the ground is white, the upper side, which is exposed to the light, is of some dark shade, either brown, or greyish sand colour, and in some instances this general hue is broken by blotches, light or dark, blackish or reddish, which not only present a resemblance to under-shades caused by inequalities of the ground, but to the different tints that occur upon it.

Flat fish, too, seem to be endowed with the power of altering their colour, so as to correspond with the prevailing tints of the ground and seaweed. When the sand is of a very light colour, they so nearly resemble it, that even in very clear and shallow water, a flat fish may be immediately under the observer's eye without being perceived.

The family of fishes which comprehend the herring, the pilchard, and several other species, is a family of the highest importance, and in several respects of great interest.

The herring has been described as having its permanent abode within the arctic circle, from which it migrates southwards towards the British Islands in a shoal of countless myriads, at certain periods of the year, and when the shoal reaches the Shetland Isles, it separates into two vast bodies, one of which proceeds eastwards, filling with their numbers the creeks and bays on the east coasts of Britain, while the other passes along the west, visiting the various lochs and bays on that part of Scotland, the Irish Sea and the Irish Coast.

This, however, appears to be a fabulous account. The herring does not possess its habitual place of abode in the arctic seas, where it is said to be extremely rare, and not only are there no herring fisheries of any importance in Greenland, or even in Iceland, but no notice has been taken of this fish by voyagers to the frozen seas.

The herring does perform a migration, for it entirely disappears at certain times and revisits our coasts afterwards; but the extent of its migration is understood to be very limited. The best naturalists are of opinion that it inhabits the deep water of our coast all the year, and only approaches to the shallow water of the shores for the purpose of reproduction, in this respect being similar to other tribes of fishes.

The pilchard is a smaller fish than its relative the herring, and is by no means of such general occurrence along our coasts. Its chief locality is the south coast of England, and especially that of Cornwall and Devonshire; and although a few stragglers may sometimes be obtained along the eastern shores of the island, yet the range of this fish seldom extends on the east beyond the Straits of Dover, and on the coast beyond the parallel of the southern shores of Ireland.

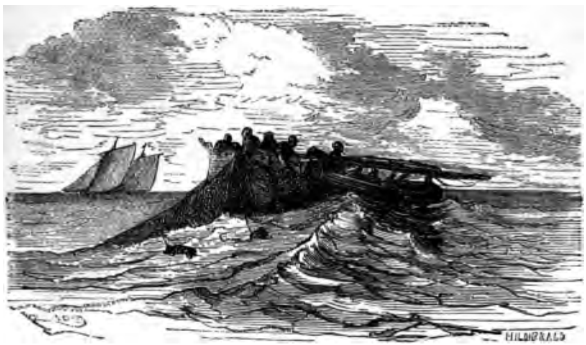
The prodigious multitude of both these kinds of fishes which are annually caught in the British seas has rendered the herring and pilchard fisheries of the greatest value and importance, employing as they do many thousands of fishermen, affording support for their families, and supplying a large quantity of food.

The mode of fishing for the herring and the pilchard is much the same.

The herring is taken by means of a net of great length and of considerable depth. These nets are suspended perpendicularly from a rope extending along the surface of the water, on which it is floated by means of buoys. These nets are run across the usual course which the shoal of herrings takes, and the fish run their heads into the meshes from which the threads entering behind the gills, render it impossible for them to withdraw, while the size of the mesh makes its equally impossible for them to pass through the net. These nets are made to extend a great distance from the boat, and having been left floating are often found, on being taken up, to contain as many

herrings as will completely fill the boat to which the net belongs.

The pilchard is taken by the same method as that employed in the capture of the herring, but the largest quantities are obtained by means of the net called the seine or sean, a form of net of great antiquity, the name of which has come down to us from the Greek language.



HAULING HERRING.

The seine is a net of great length which may either be shot from the shore or from a boat. In the latter case, other nets are used called stop nets, which are shot in such a manner as to prevent the escape of the fish already enclosed in the seine itself, by completing the circle in which the fish are enclosed.

In some instances several seines are united together,

and when fully extended, enclose a great space and frequently capture a corresponding quantity. On such occasions, several boats are employed, and when a large shoal of fish is discovered and the direction in which they are moving ascertained, the greatest activity prevails, and no small degree of skill is manifested by the fisherman.

The extent and course of a shoal of pilchards is frequently much more correctly ascertained from an elevated part of the shore; and the experienced eye of the fisherman who takes his station on an eminence enables him, from certain indications in the water which would escape the notice of others, to discover those particulars regarding the shoal necessary to a successful cast of the nets. This he easily communicates by preconcerted signals to the fishermen in the boats, who act on the suggestions thus conveyed to them.

A graphic and spirited account of the process is given in the *Athenæum*, December, 1859.

"On an eminence above the sea, and probably on a narrow path, paces a strong rough Cornishman in apparently a meditative mood. He carries a branch of a tree or a furze in his hand. He carefully scrutinises the sea, and now and then shades his eyes with his large hand, as if he would descry a far sail. A well-laden boat now shoots out to sea, and at this the solitary watcher gazes.

"Does it hold his son or his daughter? Is he full of fatherly anxiety for his son as he is about to emigrate?

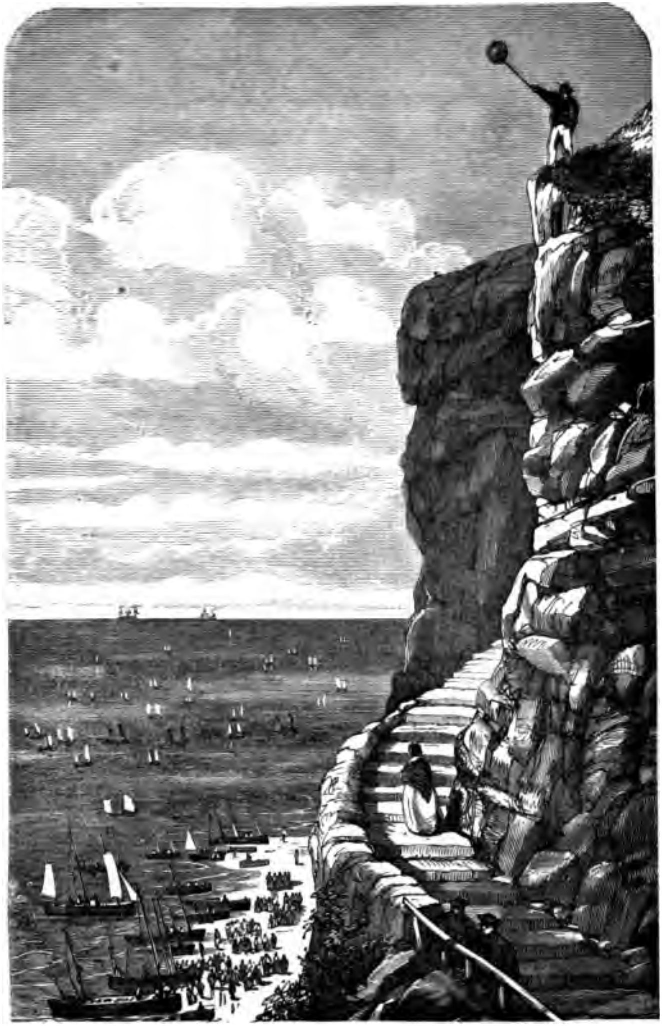
"Mark him! He now frantically waves his branch and his arm in one wide sweep. The folks in the boat see this; and strange to say, are swayed by this mad motion. He again sweeps round the branch, and as they look up to him he directs their course by it, as if it were their compass.

"What can this mean?

"Why, the supposed madman is sane and sagacious enough. He sees a faint bluish line on the surface of the waters and *there* are the pilchards in one fluctuating, changeful, life-abounding shoal. See how they leap, they play, they shift, they sink, they rise again!

"Swiftly row the oarsmen, down bend the seiners in less time than common men would think possible, down goes fathom after fathom, and heap after heap of the seine, up float the bordering corks, clash, dash, splash go the long oars again. The cliff watcher is now doubly frantic. He waves and raves, and runs and stamps, and jumps; the shoal is shifting, warping, eluding, the boat is turned, the telegraphic branch is again eyed and obeyed; and now the cliff-watcher is satisfied. He lowers his branch, he nods, he assents by every primitive symbol and significant action that can be imagined.

"The entire seine is gradually lowered into the sea, the men bend over and you dread a capsize, and even more and more when you see their motions reversed. Now they no longer let down, but haul up. A hearty shore-resounding and echo-awakening shout is their mutual encouragement—up comes bit by bit of the seine. How



PILCHARD FISHING ON THE CORNISH COAST.

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heavy! How joyfully full! Fishermen's heads almost touch the brine, their backs alone are broadly apparent. Now one strong combined haul and nearer together is the seine drawn. What hundreds of glancing, leaping, struggling, fish spring up from within that spot!

"The shore is soon lined with assistants. Some row off with 'tuck nets' to the great boat and let the said small tucks down inside the large seine.

"The waters are beaten with oars and loaded ropes, and thus the fish are frightened into a narrower space.

"Listen to the discordant noises on the shore! Boys shout shrilly; dogs bark loudly; and women chatter, and all these sounds mingle with the deep-toned nautical 'Yo! heave ho! yo! hoy! hoy! hoy!' at sea.

"Though yourself a calm reticent student when in London, you catch the Cornish enthusiasm, and as if your whole venture was in pilchards you yourself shout and shriek, and jump and rave.

"Never mind; all is right.

"To shore comes the little crowd of boats, and out on the bare beach is poured one teeming, struggling, leaping, panting mass of silvery scales!"

# THE INHABITANTS OF THE DEEP.

## CHAPTER II.

### SWORD-FISH AND FLYING-FISH.

UPON some members of the fish world nature has conferred peculiar favours, which have strikingly distinguished them from all their fellows, favours which have given to them a high place in the interests of mankind. The winged-fish and the sword-fish are amongst this number; and as having something in common with the herring and the mackerel, they may now be mentioned.

Flying-fish have their two front fins (pectoral fins) extended into wing-like length and shape. By these, they are able to project themselves out of the water, and to sustain themselves in flight through the air. Some kinds have four wings, but the more common have only two.

These remarkable creatures are a striking feature of

the Carribean, and the Mediterranean, and the Red Seas. They swim in shoals, and sometimes they leave the water in flocks of a hundred or more. They dart through the air for a distance of, at times, as much as two hundred

FLYING-FISH.

yards or more, then dipping under the surface of the water for a second, and mount again. From their swiftness of flight and their skimming motion they have been called "sea-swallows," and though they are true fishes, at

first sight there comes an irresistible supposition that they are some kind of sea-bird.

In size and in the general form of its body, the flying-fish resembles the herring. Its colour is brown shot with blue on its back, white on its belly, and orange colour at the extremities of its fins and tail, and its wings are of a deep blue. It seldom ventures out of the warm regions to which it naturally belongs, but two species have, at various times, been seen near to the British shore.

Speaking of the Carribean Sea, Canon Kingsley says:—

"The flying-fish have been, for the last two days, a source of continual amusement, as they scuttle away from under the bows of the ship, mistaking her, probably, for some huge devouring whale. So strange are they when first seen, though long read of and long looked for, that it is difficult at first to recollect that they are actually fish.

"The first little one was mistaken for a dragon-fly, the first big one for a grey plover. The flight is almost exactly like that of a quail or partridge—flight I must say, for in spite of all that has been learnedly written to the contrary, it is too difficult as yet for the English sportsman on board to believe that their motion is not a true flight, aided by the vibration of the wings, and not a mere impulse given (as in the leap of the salmon) by a rush under water. That they can change their course at will is plain to one who looks down on them from the lofty deck, and still more from the paddle-box. The

length of the flight seems too great to be attributed to a few strokes of the tail; while the plain fact that they renew their flight after touching, and only touching, the surface, would seem to show that it was not due only to the original impetus, for that would be retarded, instead of being quickened, every time they touched. But these are first impressions, which more experience may correct."

The flying-fish has no teeth. Its food requires none, for it feeds on minute creatures, such as the smaller kinds of medusa and of infusoria. They are excellent food, and though abounding in their native seas, they are never in too great a supply for the demand.

It has been assumed that these beautiful creatures left the water and sought the air as a refuge from their ever harassing foes. But there is no reason to believe that their foes are either more numerous or more voracious than the ordinary foes of fish. There seems every reason to believe that they rather take flight to exercise, like other creatures, the powers with which they are endowed, and that their flight is not the flight of fear, but the flight of joy. But still, it remains true that alike whilst swimming in the sea, and in their flight through the air, they are pursued by larger fish, such as the dolphin, and by the larger sea-birds. When pursued they will double like a hare when followed by the greyhound. Sometimes, too, they will seek refuge on the deck of a passing ship.

Light offers a strong attraction to them. Against the binnacle lamp of a ship they have been known to project

themselves with such force as to break it, though it is formed of thick, strong glass. Light is used, too, as the bait, so to speak, by which their fishers catch them.

A fire is kindled in a small holder lifted up on the end of a pole placed in the fisherman's boat. Nets are hung out across the boat, and on either side it. The fish flock in crowds in the direction of the glare, and propelling themselves with great force against the nets, bury their heads in the meshes from which they cannot withdraw. By these means large quantities become helplessly entangled.

Another remarkably endowed fish is the sword-fish, so called from the extension of its upper jaw into a long sword-like limb.

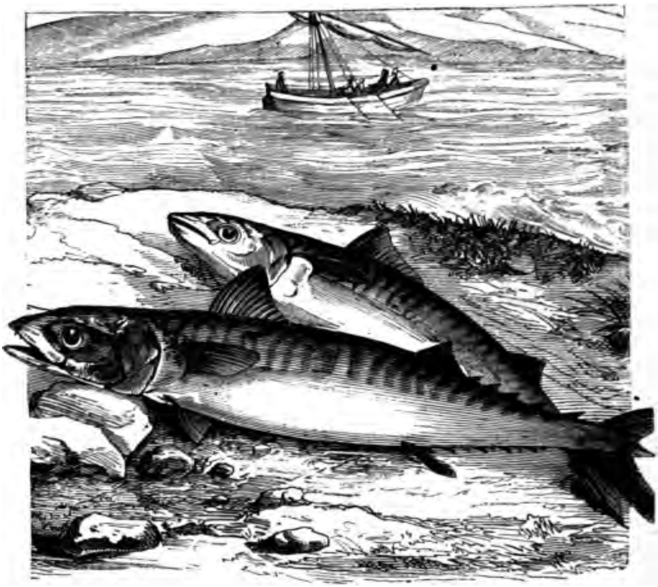
The sword-fish is of the same tribe as the mackerel, so common in British seas; ordinarily it attains the length of fifteen feet, but extraordinary specimens are found of twenty feet.

Though family relatives abound along our coast, it is only rarely that the sword-fish itself is found in British seas, and then only small specimens of it. Its home is the Mediterranean and tropical seas.

Like the mackerel, the sword-fish is an exceedingly greedy and pugnacious creature, and always carrying with him a long, finely-enamelled rapier, he is able to indulge his pugnacity in a soldier-like way. This weapon is from five to seven feet long.

With his ever-drawn sword he slays other fishes for his food, and at times will run full tilt against the hull of

a ship. The force with which he can throw himself against his chosen foe is variously stated; but there is good evidence that he can pierce solid oak to a depth of eighteen inches. In these cases the evidence is found in



MACKEREL.

the timbers of ships in which to this depth part of a fish's sword has been embedded; and, snapping off, has been left to be discovered when the disused ship was being broken.

The wonderful power of this fish is greatly increased by the maddened temper in which it is often found. Small parasitic creatures bury themselves in its flesh, causing it great torment. Under the influence of the pain these minute enemies cause, this warrior of the deep will conduct himself in the wildest manner. Wonderful and fabulous stories are told of his deeds at such times; but one thing is certain, that he will run himself aground, as either seeking to destroy himself or to rid himself of his foe.

# THE INHABITANTS OF THE DEEP.

## CHAPTER III.

### SHARK AND SKATE.

SPECIMENS of almost every species of the shark family —*Squalidæ*—have been found on the British coasts, but the largest and most formidable of the tribe are rare.

Most visitors to our sea-side aquaria must be familiar with one or other of the minor species of shark, called dog-fish, of which there are several kinds, and which frequent some parts of our coast, in immense multitudes, occasioning great havoc among the nets and fishing lines, and often tearing to pieces the best fish on the hooks.

The teeth of sharks are not mere objects of natural dread. They are at a respectful distance objects of considerable interest, being furnished in a peculiar manner. They are not fixed in sockets, but attached to

a cartilaginous membrane. This membrane grows outward; the outer row of teeth in due time drop out, and another row which has been gradually advancing occupies the place of the first; this in due time disappears, and other sets follow in succession.

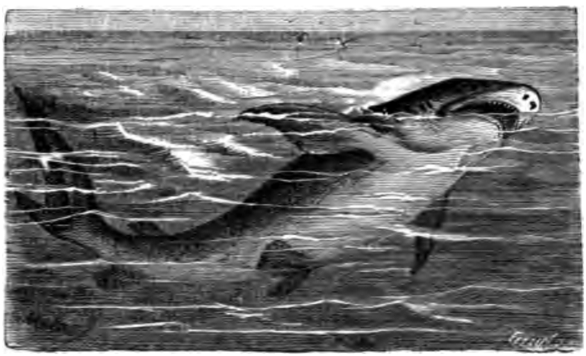
By this means, even in the oldest of these monsters of the deep, the teeth are always in the most perfect condition for the work of destruction for which they are destined.

Everybody connected in any way with the sea, is always delighted when a shark is killed. A shark is the great water enemy of mankind; the delightful bathe is either impossible or bereft of half its pleasures when sharks are known to be near. A boat that is upset causes a fatal accident in shark-frequented waters, whereas it might produce only a ducking under other circumstances. Thus a sailor believes that he who kills a shark deserves well of his country and companions.

The shark dies a craven; he affords very little of that sport which renders trout and salmon fishing so attractive; his first rush as he feels himself hooked is usually powerful enough, but after that he exhibits little but sullenness. A young shark is usually more vigorous and determined in his resistance than is one of larger growth, and with these we have had good sport. In most rivers of tropical countries sharks will be found near the mouths, especially at high tide, and those who are disposed for sport only, will find ample in such localities.

"The plan we adopted," says Lieutenant Drayson, in his

paper on "Unusual Fishing," "was to procure two pieces of copper wire, twist these firmly together, and lash a hook on to the end. A stout piece of cord was then made fast to the wire, and a bladder attached to the cord. About a hundred and fifty yards of cord were coiled up on the bank in order to play the hooked fish, a piece of meat was then fastened on the hook, and the bait flung out seaward.



SHARK.

The hands for this work ought to be protected by a stout pair of leather or India-rubber gloves, so that a check may be given to the cord as the fish runs out with it.

"Having made our preparations in this way, we cast our line, and had scarcely secured the end than we saw the bladder, that indicated the position of our hook and bait, travel rapidly up stream, bob under water and again

appear. A rapid tug at the cord was resisted, and immediately afterwards the line flew through our hands, nearly a hundred yards being paid out without a check. Then we, however, obtained a pull at our captive, and brought him near the shore, sighted him, and saw he was a shark about four feet long.

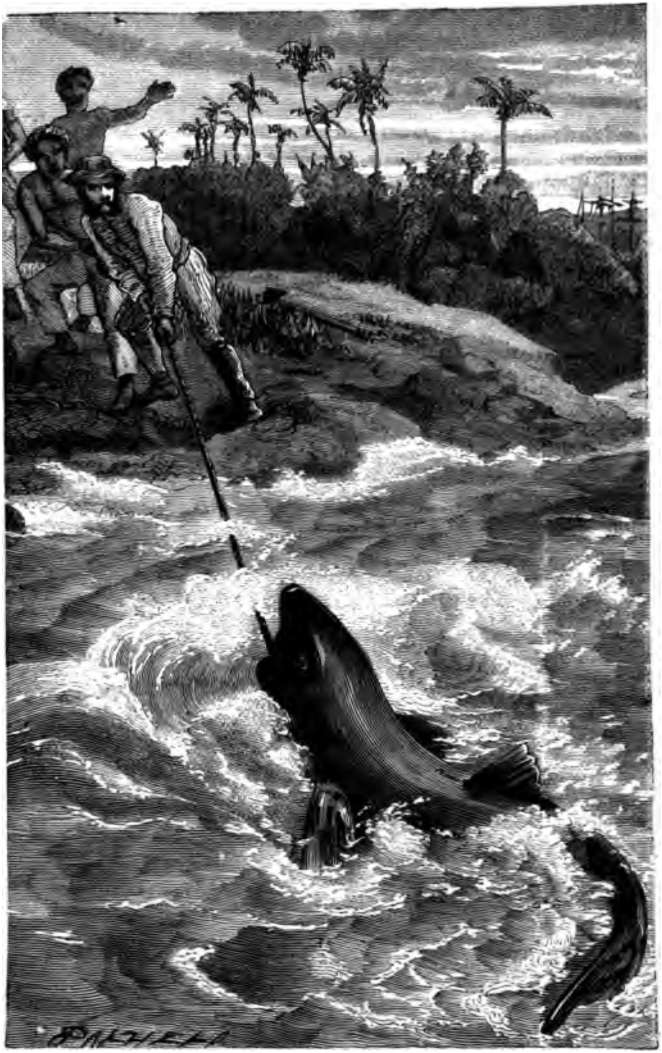
"When the young cannibal saw us he struggled hard to escape, but his ravenous appetite had been his ruin, as the hook was deeply buried in his throat, and in ten minutes from the time of his being hooked, he was dragged snapping and wriggling on to dry land.

"On more than one occasion, however, the fish we thus hooked was too much for us, and carried out and off the whole of our line, and had we not resigned the end we ourselves would have been dragged into the sea, our efforts being feeble in comparison to the power of the monster who had swallowed our bait, and was equally capable apparently of swallowing us."

Numerous are the tragedies that have taken place with the shark. One or two we will refer to.

A party of soldiers were bathing near the shore on one of our Mediterranean stations, where sharks are usually considered harmless. Above a hundred men were in the water together, some far out, others close in shore, when the alarm was given that a shark was approaching. Scarcely had the note of warning been given, than the shark, passing by a score or more of men, seized one who was quite near the shore, dragged him under water, and disappeared with him; the shouts,

SHARK-FISHING FROM SHORE.



SHARK-FISHING FROM SHORE.

frantic beatings of the water, &c., of the men being of no avail to make the monster give up his prey.

A shark had for several days been seen following a ship, but no attempts had been made to capture it. A ship's boy, however, determined to have a trial, and having prepared his hook and line, clambered into the ship's chains, in order to throw out his bait. Unfortunately, the jerk caused by throwing overbalanced the boy, who fell into the sea. A rush was made aft, and a rope cast towards the lad, who was, as is usual with sailors, unable to swim. The effort failed to save him, and in another second he was approached by the sea monster, which, slightly turning its head, seized the boy and dragged him under water, disappearing from the sight of those on deck, and of those who entered the boat in order to revenge his death.

We ourselves were once in very unpleasant proximity to a shark. We were in the habit of bathing every morning soon after sunrise, and had arranged a long plank on piles, as a sort of spring-board. Having started along this plank as usual, and reached nearly the end our balance having been lost, we cast our eyes down, and there beneath us, not five feet under water, was a shark double our own length. With that instinct which comes to all of us in times of danger, we at once felt that the safest plan was to jump at the shark rather than try to avoid him, and thus we directed our plunge at him. We had to swim some forty yards to regain the shore, and this was indeed trying work; but the shark had made off,

and we lived to tell the tale—he probably being alarmed at the attack threatened by our plunge at him.

The family of fishes, known as Rays or Skates—*Raiidæ*—are also numerous in our seas. They belong, like the sharks and lampreys, to the cartilaginous division of fishes.

Of the rays there are many varieties, some are scarce, and others are in great plenty.

Several of the shark tribe bring forth their young alive; but others produce eggs, as also do the rays, and these are not deposited in large multitudes, like those in the spawn of other fishes, but in comparatively very small numbers, and each egg is contained in a case formed of a thin horn-like substance, and of a very remarkable shape.

Those produced by the skate are about four or five inches in length, of a dark brown colour, similar indeed to the darkest sea-weed when dried; their shape is as near as possible that of a four-handed barrow, but with these our readers are probably familiar, as they are frequently found empty on the sea shore: they are called mermaids' purses or skate-barrows.

Those belonging to the dog-fishes are very much like the purses of the skate, but are of a clear yellowish horn-colour.

From each of the four corners of the purse issues a long tendril which coils round the sea-weeds or other substances near which the parent fish deposits it, and it is thus so fixed as to be free from danger of being driven ashore by the waves. Both kinds of purses are furnished

with openings at the ends through which the sea water flows while the young fish is being matured, and by which it eventually issues forth from its very singular envelope.

Remarkable, however, as these "sea-purses" are in

SKATE.

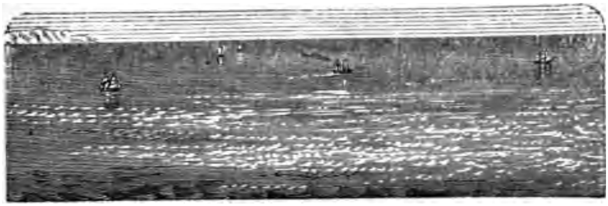
form and structure, there is one particular regarding them which presents us with a most striking instance of a provision made for the wants of the young fish before it is able to quit its prison.

During its embryo state it cannot use its gills for breathing. Yet in order to the development of the fish, it is indispensable that through its circulating system the blood shall pass purified by the action of the water, and supplied with oxygen as it is required. Without this process the young fish must perish.

And how is this accomplished?

By a very marvellous expedient.

From the gills of the young fish project certain filaments; each of these contains a minute blood-vessel, and as the water has free ingress to the interior of the receptacle, these blood-vessels serve the purpose of gills. They are, however, entirely temporary; they cease to exist after the tiny creature is set free from his prison, and in his new and enlarged world his gills are capable of acting.



# THE INHABITANTS OF THE DEEP.

## CHAPTER IV.

### SUCKER-FISHES AND STICKLEBACKS.

MANY of the finny denizens of our sea-shores are very remarkable in their structure, habits, and instincts; various marine animals are furnished with disks, by which, in consequence of the law of atmospheric and fluid pressure, they are enabled to adhere with great tenacity to those objects to which their disks are applied.

One of these, the lump-sucker (*Cyclopterus lumpus*), is frequently taken on various parts of our coast, and often found cast ashore. This is by no means a handsome fish. Its form is thick and clumsy, its skin rough and covered with tubercles, and although the various tints of blue, purple, and orange are mingled together over its surface, its general aspect is not pleasing. The flesh is rich, but it does not agree with all stomachs, owing to

the quantity of oil it contains. Seals devour them with great avidity.

This fish is extremely remarkable on account of the apparatus by which it can attach itself at will to the surface of other bodies. This apparatus, which is popularly termed a sucker, is situated on the lower part of the creature's body, and consists of an oval-shaped disk or flat surface, furnished with muscles by which a vacuum can be created between the disk and the object to which the fish adheres.

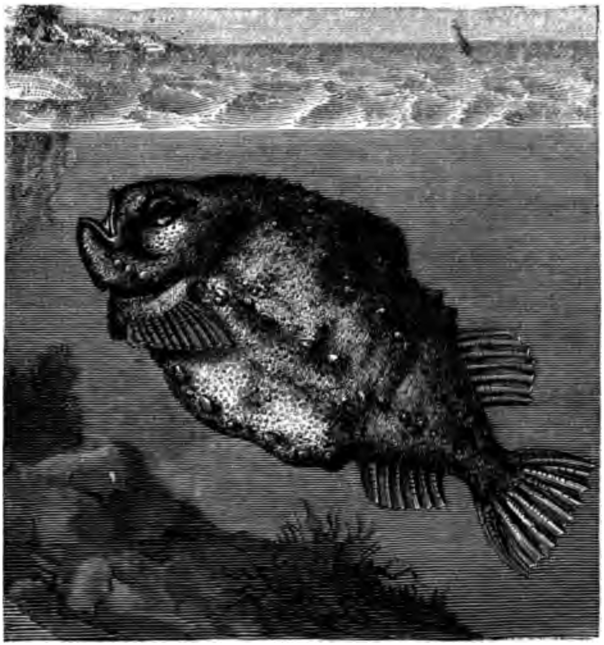
Such is the tenacity with which it is able to fix itself by this means, that one of these fish having been placed in a bucket of water, it attached itself so firmly to the bottom that the whole vessel, containing several gallons, and of considerable weight, could be lifted from the ground on using the fish's tail as a handle.

It is difficult to ascertain all the purposes which are served by this part of the creature's structure, but one purpose appears evident.

The lump is not an active or powerful fish, and its shape exposes it in no ordinary degree to the power of the waves. By means of its sucker, however, it can bid defiance to their utmost force, and remain amidst the agitation of the water free from all danger of destruction. We are entitled to regard the sucker in this particular instance as a compensation which makes up for want of greater activity and power.

The spawn of the lump-sucker is deposited among rocks and sea-weed within low-water mark, and the male

fish is said to watch the spawn after its exclusion until the young fry are hatched, when the latter instantly employ their suckers by fixing themselves on the sides



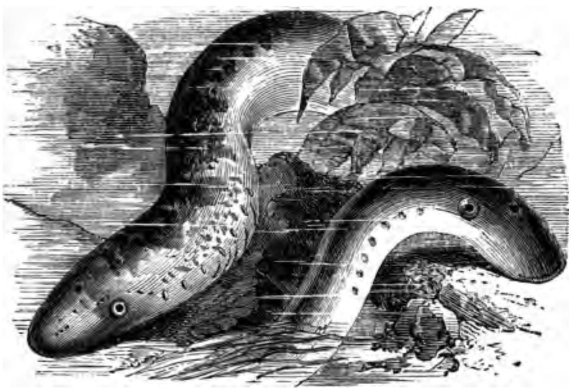
LUMP-SUCKER.

and back of their parent, by whom they are carried into deeper water.

There are other fishes which are provided with

"suckers," constructed on precisely the same principles as that of the fish now mentioned, but apparently employed for different purposes. One of the most remarkable of these is the lamprey (*Petromyzon marinus*), specimens of which fall under our notice on various parts of the English coast much more frequently than on the shores of Scotland and Ireland.

This fish has an eel-shaped body, and is from two to

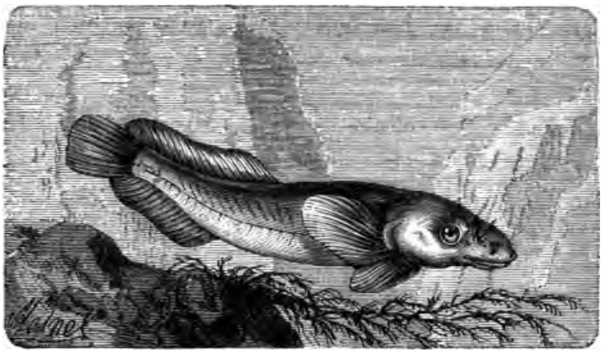


LAMPREY.

three feet in length; its colour is a yellowish-brown marbled with a dusky hue. It is, like the salmon, a migratory fish, passing a portion of the year in the sea, and entering the rivers in spring for the purpose of spawning.

The remarkable peculiarity in its structure is the mouth, which is circular, surrounded by a flexible lip, and

armed with a very singular tooth. The lamprey feeds, like the eel, on any animal matter it finds; but it occasionally attacks other fishes, fastening upon them with its sucker-shaped mouth, and cutting into their flesh with its tooth-like processes evidently adapted to the purpose. This is not, however, the only use to which its sucker is applied.



PORT-PORRINGER.

The fish is imperfectly adapted for swimming, having neither air-bladder nor pectoral or ventral fins; by means of the sucker, therefore, it can in no small degree remedy the defects of its natatory powers, by attaching itself to stones, and thus not only obtaining rest, but perfect security against the strength of the current.

Another and very distinct use of the sucker remains to be mentioned. The lamprey, prior to depositing its

spawn in the rivers, finds it necessary to prepare a place for its reception, and this it does by removing the small stones from the spot in which the roe is to be laid.

In the rivers they frequent, the male and female lamprey may often be observed from a bridge, busily occupied in this, to them, important process. To those who are not aware that substances immersed in water are much lighter than in air, it is quite marvellous what large stones the lampreys contrive to carry from the place which in their parental instinct they are preparing for their progeny.

The structure of the lamprey's mouth is precisely analogous to that of the little apparatus called a leather sucker used by boys at school, or to the mouth of an exhausting syringe. It is, however, like all instances of natural mechanism, much more perfect than any artificial apparatus can ever be. In this particular instance we find the mouth serving not only for the reception of food, but for a variety of purposes, to any of which, if its form were similar to that of other fishes, it could not be applied; and for which, even if its shape were circular, it would be unfit if unaccompanied by an apparatus for creating a vacuum, and by an implanted instinct adapted both to the structure and to the wants of the animal.

Among other specimens is what Yarrell calls the Bimaculated or two-spotted Sucker.

Their form is flattened; they have a broad shovel-shaped muzzle, prominent eyes, looking rather upwards, and the head much widened behind; the head, indeed,

constitutes more than one fourth of the entire length, and at its hinder part or where the gills open is far wider than any other part of the fish. They rarely exceed an inch and a half in length. The general hue above is pale red; but in some specimens they become a nearly uniform lake purple, in others the hue is a clear orange, while yet in others it is almost white. A band of white, bounded by darker lines, almost invariably connects the two eyes. Frequently the hue of the body is varied by clouds and patches of dark reddish brown, which patches have a tendency to assume a constant pattern, quite recognisable when you look at a good many specimens together. In the hinder half and on the sides the ground colour is apt to be minutely divided or mottled, the interspaces being of a delicate azure or lilac; and when examined with a lens, the whole surface seems sown with gold-dust.

The eyes are exquisitely beautiful; and as they are prominent, very movable, full of inquiry, and especially as they are moved quite independently of each other, they at once attract and fix the admiration of the beholder. The large pupil is of a deep lustrous green, the iris of the most brilliant orange gold, and the whole set as it were in the midst of a globe of the purest glass. On the whole, I scarcely know of a more attractive little fish than this.

Our readers are all, doubtless, acquainted with those active little fishes, which from their being armed on the back with spines, are called sticklebacks.

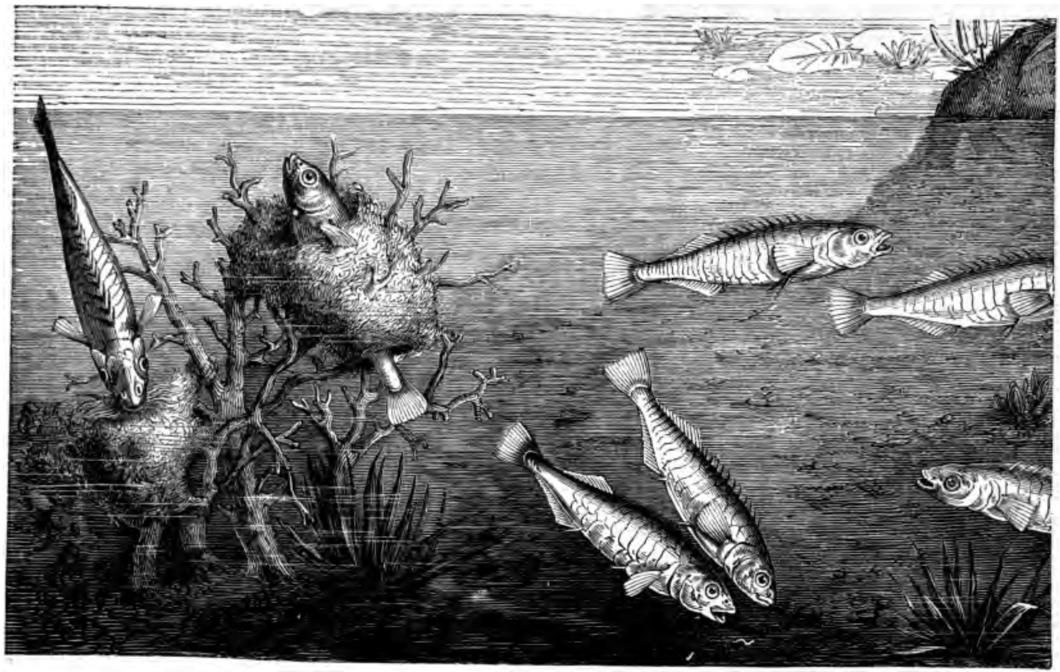
There are several varieties of these, but they inhabit

fresh water, although some of the species are found on the brackish water at the mouths of our larger rivers. There is, however, one species which is entirely a salt-water fish, and is found in a great variety of places on the coasts of Britain and Ireland. It is the fifteen-spined stickleback, and is sometimes called the sea-adder. It inhabits places where there are rocks and stones, covered with seaweed, among which it takes refuge when alarmed.

The most interesting circumstance regarding this little fish is its nest-building instinct.

The nest may often be discovered during spring and summer in the rock-pools between tide-marks. The structure is about eight inches in length, pear-shaped, and formed of branches of seaweed, intermixed with confervæ and corallines. To unite these materials together, the little architect forms a thread as fine as silk, and strong as well as elastic, for which purpose it is furnished with a secretion capable when drawn into a thread of resisting the water. With this thread, which is frequently of great length, the fish binds together the seaweeds forming its nest, carrying it through and around them in all directions.

In the middle of this nest the spawn is deposited in irregular masses, containing many hundreds of eggs of a whitish or amber colour, and about the size of small shot; the masses of eggs in the same nest are met with in different stages of advancement towards maturity, from which it appears that the fish deposits its spawn at various times in the same place.



STICKLEBACKS AND THEIR NESTS.

The care of the little creature does not cease with the deposition of its spawn; it watches the scene of its parental toils, with anxious solicitude guarding it from all danger, so far as its limited powers will allow, till the young fry are excluded.

# THE INHABITANTS OF THE DEEP.

## CHAPTER V.

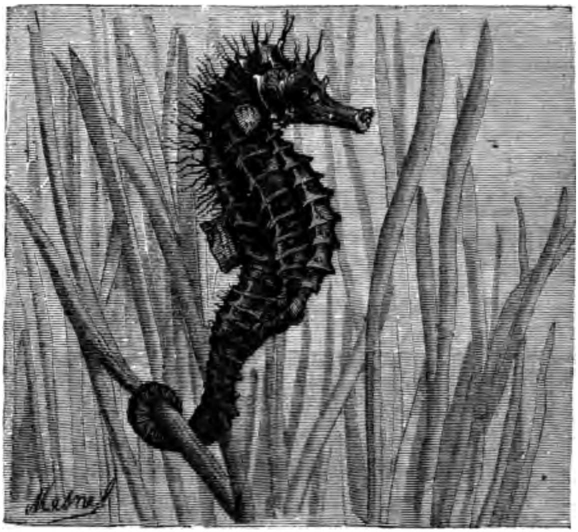
### PIPE-FISHES AND FROG-ANGLER.

THE family of Pipe-fishes (*Sygnathidæ*) is represented in our seas by some species, specimens of which are to be found in various parts of our sea-shores.

The appearance of all this tribe is most remarkable; their bodies are long and slender, their snouts much elongated, and the whole body is covered with plates, like a coat of mail, and the plates are so disposed that the body is rendered angular. What is more remarkable still is the fact that, like the kangaroo, these fishes are furnished with a marsupial cavity, into which their young may retreat.

Of this tribe there are seven species known on our shores, and differing from each other in various minute respects. Perhaps the most remarkable of these is the

species known as the short-nosed sea-horse, which is a kind of pipe-fish, somewhat rare on the British shores, although frequent on the continental coasts. The name is suggested by the resemblance which the head of the fish bears to that of a horse.

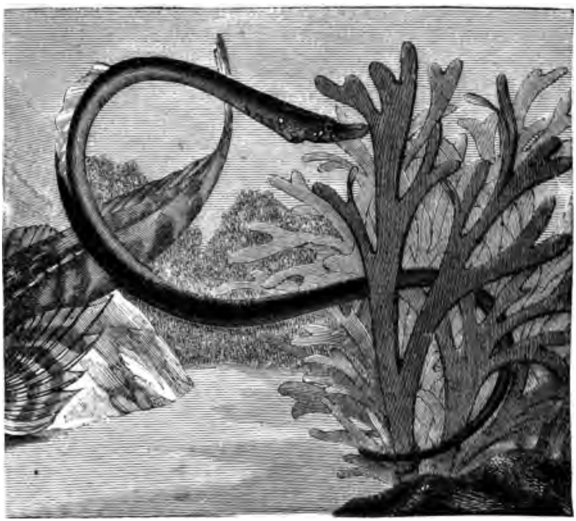


SEA-HORSE.

The animal, it appears, is accustomed to use its tail as a prehensile instrument, for which the shape and position of the plates by which it is covered, adapt it; and it is enabled to twist it round marine plants, and wait with its head free, ready to dart upon any object it desires to

make its prey. It is said to swim in a vertical attitude, with the tail ready to catch any object within its reach.

Two of these singular fish sometimes engage in combat, when they twist tails round each other, and struggle with great violence.



WORM-PIPE.

The eyes have the faculty of moving independently of each other, and this, along with the brilliant iridescence about the head, gives it a considerable resemblance to the chameleon.

Among these pleasing little fishes some very remarkable

deviations from the ordinary economy of animals occur, though not quite unique. In almost all the mammalia of Australia, as is well known, the female has an external pouch or false belly, into which the young is transferred at a very early period of embryonic life, and there matured. In the *Pipa*, or Surinam toad, the eggs are laid by the female, and placed on the broad back of the male, a cell being then formed in the skin, which receives the egg till it is hatched. Somewhat like the latter is the case of the pipe-fishes, among which it is the male that acts as wet-nurse. Along his belly runs a groove, formed by two flaps of skin, within which the eggs, when laid by the female, are placed, and in which they are safely carried till the birth of the infant fry.

Among the most remarkable fishes which can attract our attention is the Fishing-frog, or Angler (*Lophius Piscatorius*), a creature whose structure and instincts are very marvellous.

This fish is frequently taken three or four feet in length, and is said occasionally to be found of the dimensions of seven, and even ten feet in length. Its head is flat, and of enormous breadth and size, its surface exceeding that of all the rest of the fish, and the mouth is prodigious, and armed with numerous teeth.

The most singular part of the animal's structure are three tentacula, which arise from the head. Two of these filaments arise from above the upper lip, and the third from the back of the head. The first of these, on the upper lip, is nearly half the length of the fish's body; at

its base it is accommodated with a joint, which admits of its motion in every direction, and at the extremity it is surmounted by a little membrane of a brilliant metallic lustre. This filament constitutes the rod, line, and bait, by which the fishing-frog entices its prey.

It swims with difficulty, and instead of pursuing its prey it has recourse to a degree of craft rivalling that of a disciple of Walton himself.

Crouching close to the ground, it stirs up the sand and mud with its fins, and thus concealed from the sight of its victims, it elevates its fishing-rod and bait, moving the coloured membrane about in all directions. This attracts the fishes in its vicinity, who hasten to seize upon the tempting bait, but they no sooner attempt to nibble at the apparent worm than the angler withdraws the lure, and elevating his enormous mouth, seizes his unsuspecting prey, and, swallowing it in a moment, immediately holds out the bait to capture another prize.

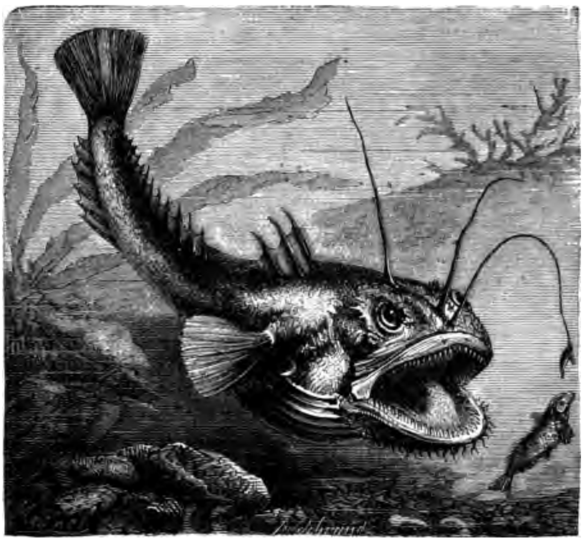
Many authentic anecdotes are related of the voracity of this fish, a quality which the extraordinary magnitude of its mouth unequivocally indicates.

A fisherman had hooked a large codfish, and while drawing it up he felt a much heavier weight attach itself to his line. This proved to be a large angler, which had seized the cod, and which the fisherman compelled to quit its prey only by giving it some heavy blows on the head.

On another occasion, an angler seized a large conger-eel, which had taken the hook, and was in the act of

swallowing the huge morsel, when the prey escaped from the angler's jaws by finding its way out by the gill-covers behind the mouth; and in this condition both were drawn up together.

Another of those fishes, pressed by hunger, is known



FROG-ANGLER.

to have seized at the top of the water a large cork buoy employed as a float for a deep sea-line; and it is said that some fishermen near Queensferry, in Scotland, observing the water much discoloured at one particular spot where it was not very deep, rowed to the place, and, on poking

the bottom with a long-handled mop, found it taken hold of by an angler, who was, doubtless, busily engaged plying his vocation, and who, mistaking the mop for a fish, seized it with the intention of swallowing the savoury morsel; the woolly substance of the mop, however, caught in his teeth, and being unable to extricate himself in time, he was hauled into the boat, the victim of his own inordinate appetite.

It is to the structure and instincts of this singular creature, however, that we would especially direct attention.

From what has already been stated, the mechanism of the fishing-rod, as we may call the filament with which it entices its prey, is adapted with extreme nicety to its purpose. The peculiar form of the joint by which it is fixed admits of its being moved in every direction, and it is supplied with a set of muscles under the control of the animal's will, while the size and position of the mouth, and the situation of the eyes with reference to the membrane or bait at the end of the rod, are precisely such as to be most efficient.

To these peculiarities, we must add the instinct and craft, without which the structure could not be available; but what is more, the structure and instinct are both adapted to the instinct of other fishes, who, in pursuit of food, mistake the angler's lure for some living object, such as they are wont to pursue.

# THE INHABITANTS OF THE DEEP.

## CHAPTER VI.

### ORGANIZATION AND INSTINCTS.

FISHES exhibit great variety of form; but notwithstanding such special differences of shape as exist in different examples of the class, the general form which they all pcssess in common is in all instances such as to fit them for rapid and easy motion in their native element; those whose motion is swiftest, such as the salmon, having precisely such a figure as may be shown, on the strictest principles of physics, to be that which presents the least resistance to the fluid through which they swim.

Their centre of gravity, too, and their specific gravity, or the weight of the fishes' body compared with an equal bulk of water, are such as to adapt them with the nicest accuracy to the fluid in which they exist.

The external covering and the colours of fishes present to us many striking lessons to the same purpose.

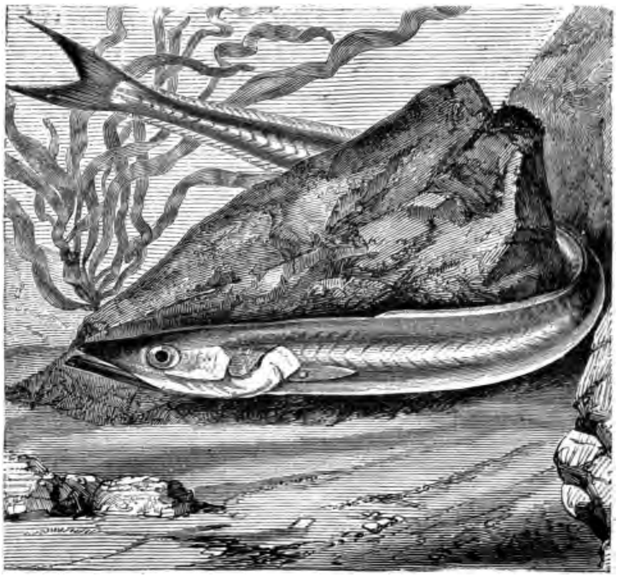
One of the distinctive characters of fishes is their scales, which constitute a covering peculiarly adapted to the element in which they live. These organs differ in form in various fishes; some are round, some oval, others are angular, and others are denticulated. They envelope the

FISHES, SHOWING SCALES.

body so completely as to protect every part of it, and, at the same time, admit of that perfect flexibility which is requisite to those rapid and graceful motions, for which the finny tribes are so remarkable.

On examining the scales with a microscope, it is found that each of these organs is pierced by a minute hole, which is the extremity of a tube. Through this orifice is emitted

a kind of mucus or slime, which is secreted by glands, and forms an external coating, which not only lubricates the body of the animal, but diminishes the friction of its transit through the water. The orifices are found to be more numerous and larger about the head of the fish than



SAND-LAUNCE.

the other parts of its body, and in this we perceive an additional evidence of creative foresight acting in correspondence with the laws of physics; for, as Mr. Yarrell has observed, " whether the fish inhabits the stream or

the lake, the current of water in the one instance, or progression through it in the other, carries this defensive secretion backwards, and spreads it over the whole surface of the body."

This provision is analogous to that which is found in the structure of birds. A gland is made to supply the oily matter by which the feathers are smoothed, and rendered impervious to moisture.

The colours of fishes are likewise most remarkable. Nothing can exceed the beauty of the metallic lustre which some of them possess.

The herring, for instance, when just taken from the water, presents a variety of iridescent hues; and there are many fishes, the external decoration of whose scales exhibits the most brilliant tints of gold, silver, copper, blue, green, and scarlet, distinct or intermingled.

The colours are all most brilliant when they are in full season, and at the period of reproduction; and it can hardly be doubted that those bright hues contribute in some manner to the happiness of those tribes which inhabit the world of waters.

The locomotive organs of fishes exhibit admirable mechanical contrivance.

The tail, including the lower extremity of the body, is the principal organ of motion. By means of this apparatus the fish can turn to either side, or propel itself forwards. A stroke of the tail to the right or left turns the head of the fish in the opposite direction; a combination of strokes in both directions causes it to dart

forwards. The action of the tail in causing progression is, our reader will observe, an illustration of what natural philosophers call the composition of motion, the two forces which separately would move the right or left, producing as their combined result motion in an intermediate direction, that is to say, straight forwards. Human ingenuity has in various ways applied the same combination of force for a similar end.

A boatman at the stern of a boat, by means of a single oar, turns the boat to the right or left, and by combining the two motions of the oar which separately produce that result he imparts to the boat an onward motion. The screw placed at the stern of the steamship is an application of the same principle.

The fins of fishes, which are analogous to the legs of quadrupeds, appear to be chiefly employed in balancing the animal's body, and their structure is no less admirably adapted to this purpose than the tail is to its own proper effect.

Related to the locomotive powers of fishes there is a peculiar organ possessed by many species, which cannot be too much admired.

It has been already remarked that the weight of a fish's body is nearly the same as that of an equal bulk of water.

This equality, where it is perfect, has the effect of causing any body immersed in a fluid to remain in one and the same place without sinking or ascending. An increase of the weight of the body in relation to the water

causes it to descend, while a diminution of its relative gravity obliges it to rise toward the surface.

Now, many fishes are furnished with an internal piece of mechanism, by which they are able in an instant to alter their specific gravity, and to ascend or descend without employing either fins or tail. This apparatus is called the air-bladder. It consists of a membranous bag, filled with air secreted by the fish. This bag is surrounded with muscles, on which the fish can act at will.

By relaxing those muscles the bladder becomes larger, the body therefore, is specifically lighter, and ascends; by pressing on the bladder with the muscles its size is diminished, and the animal sinks. This apparatus, although possessed by a great variety of fishes, is not universal. Many of those which live at the bottom of the water are not furnished with it, and for the obvious reason that they do not particularly require it.

The gills, or apparatus for respiration in fishes, present a singularly beautiful adaptation of means to the end in view. These organs consist of arches on each side of the head, to which are attached a series of fringes, formed of minute blood-vessels, and so constructed that the water taken in at the mouth passes freely over them, imparting to the venous blood they contain the supply of oxygen necessary to its purification. These organs are precisely analogous to the lungs of terrestrial animals, and point out the same design adapted with equal precision to the element in which the animal breathes, and for a similar purpose.

The eyes of fishes exhibit several striking peculiarities pointing out special design and adaptation. As the medium in which the sense of sight is to be exercised is much more dense than air, the form of the lenses of the eyes is accommodated to the condition. The pupil also is large, so as to admit as much light as possible to enter.

In terrestrial animals the organ of sight is furnished with glands by which a fluid is secreted, in order that the surface of the cornea may be kept perfectly clean. This fluid forms a wash which is passed over the eye by what is called the nictitating membrane.

But in the fish this apparatus does not exist, because it is unnecessary.

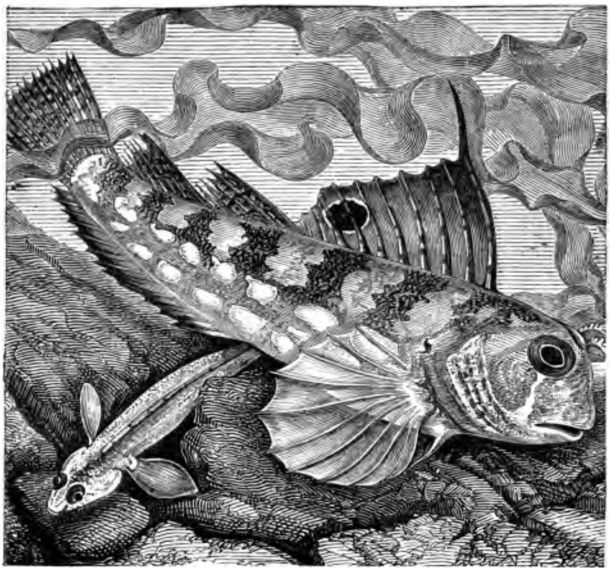
The element in which the animal lives performs the office of keeping the organs perfectly free from any substances which might impede the entrance of the rays of light.

One of the most highly curious illustrations of the precision with which instinct in fishes has been observed to act is furnished in the case of the Butterfly Blenny, in itself one of the most beautiful of British fishes.

Mr. Ross of Topsham, an excellent marine zoologist, says of the blenny :—

" A specimen of the fish was brought to me on the 3rd of June. On placing it in a glass vessel of sea water, it appeared perfectly quiet for some hours, but at length became restless and made frequent attempts to throw itself out of the water. It then occurred to me, that on

a former occasion, when by the sea-side, I had a gatte-ruginous blenny, in a vessel with some actiniæ and serpulæ, which regularly passed a portion of its time on a stone; I therefore placed one in the glass. The *Blennius pholis* immediately leaped on it completely out



THE BUTTERFLY BLENNY.

of the water. It therefore appears that these changes are necessary to its existence. On going to the front of the house I perceived that it was near low water. Knowing that it would flow till ten o'clock that night, I watched the

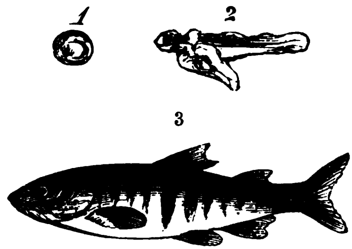
movements of my little captive, and as the clock struck had the gratification of seeing it plunge again into its natural element. It has now been more than five months in my possession, and has proved throughout that period a regular and correct tide-indicator. I was well aware

SALMON LEAPING UP RIVER-FALLS.

that these fish are constantly left by the receding tide on the rocks, remaining concealed in small basins or holes, under the weed, till the returning flood: still I was not prepared to see a fish voluntarily quit the water, and pass so large a portion of its existence in a different element,

and ɒy instinct alone time its change of position so exactly.

If we now turn our attention to the instincts of fishes, we shall perceive much that is calculated to point out the same divine wisdom and foresight which is manifested in their organization. Without entering upon any discussion as to the nature of that marvellous power which we call instinct, we shall merely at present refer generally to one of the most striking instances of its




SALMON.

1, Egg; 2, Young, newly hatched, and ᴗ, a month old.

exercise on the creatures we are now considering, that by which fishes are directed in the process of reproduction.

In order to the vivifying of fish-eggs or spawn certain conditions are indispensable, which could not be attained in deep water, such as a certain degree of exposure to light, warmth, and the influence of the atmosphere. To accomplish this end, there is an instinct implanted precisely adapted to the object in view. Directed by

this unerring impulse, fishes at the breeding season betake themselves to such stations as are best suited to the continuance of their species. The herring, for example, frequents the comparatively shallow waters of the coast, and the salmon enters the rivers from the sea, and proceeds to shallow parts of the streams, where the conditions necessary to the fruitfulness of its spawn can be obtained.

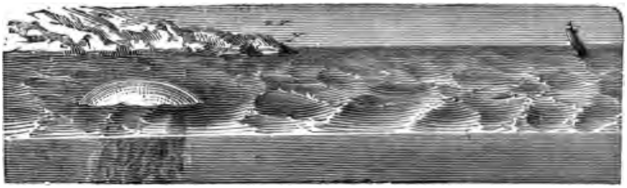
This instinct, displayed as it is in a great variety of forms, must be regarded as arising from no perception on the part of the animals exercising it, as to the importance of the act they perform ; it is accompanied by no knowledge whatever of those physical and chemical laws to which it is adapted. The tendency to act in a manner suited to those laws is a part of their constitution.

The skeletons of fishes are formed either of cartilage, as in the skate, or of bone, as in the trout or perch. This circumstance has been adopted by the illustrious naturalist Cuvier as the basis of his classification. He has accordingly divided fishes into two primary groups, the one comprehending all the osseous fishes, the other all the cartilaginous tribes.

# THE INHABITANTS OF THE DEEP.

## Part III.

## MOLLUSCS.



# THE INHABITANTS OF THE DEEP.

## Part III.—Molluscs.

### CHAPTER I.

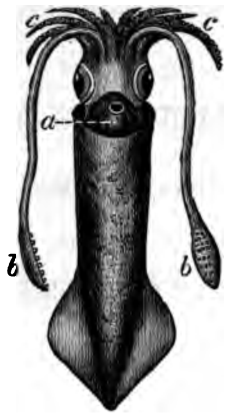
#### CUTTLE-FISH.

EVERY part of the ocean, both in the tropics, and in the arctic regions, is inhabited by members of the mollusc family; a very extensive primary group of animals called molluscs, from the Latin word signifying "soft." Some burrow in the sand and mud, others crawl among the rocks and sea-weed. The form and colours of many of the molluscs are so remarkable and beautiful, as to defy all attempts to describe them.

Some of the shells of microscopic molluscs are so inconceivably minute as to pass readily through a hole pierced in paper with the point of a fine needle. Others,

again, are of enormous dimensions; the Giant lamp-shell, a huge bivalve, being said to attain the weight of about a quarter of a ton.

The mollusca have been divided into two distinct groups, to which naturalists have given appropriate names. The one group comprehends all molluscs desti-



COMMON SQUID.*

tute of heads, of which the oyster is a familiar example, and this group is therefore called the *Acephala;* the second group is denominated *Encephala*, because comprehending animals furnished with heads, and of which the garden-snail affords a well-known type.

The cuttle-fish belongs to the group *Encephala*, and to

* *a*, funnel; *b b*, two of the "feet" elongated to form tentacles, and bearing suckers at their extremities; *c c*, ordinary feet furnished with suckers.

that division of the group whose heads are their organs of locomotion and for this reason called *Cephalopoda*, or head-footed.

The cuttle-fish is in its organization the most elevated of all the class to which it belongs. The muscular and nervous system of the cuttle-fish, its organs of respiration,

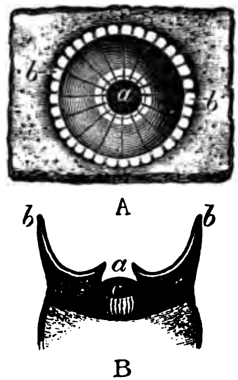



DIAGRAM OF CUTTLE-FISH SUCKER.*

and its internal skeleton, contribute to give it a close analogy as regards its structure to those animals known to naturalists as the vertebrata, because furnished with a backbone.

* A, Diagram of a sucker as seen from above: *a*, circular aperture in the centre of the sucker; *b b*, cartilaginous rim or border of sucker. B, Diagrammatic longitudinal section of a sucker; *a*, central aperture in profile, at the base of which the retractile muscular piston (*c*) is seen; *b b*, cartilaginous rim in section.

The cuttle-fish may often be found cast ashore after a storm. Let us suppose our reader to have discovered one, and submitted it to an examination.

The body, it will be perceived, is soft, although it feels not unlike a kind of cartilage. The arms, or feet, eight in number, are arranged around the top of the head, and are covered with a multitude of small circular disks raised above the surface of the adjoining skin. From the midst of these arms extend two long tentacula, which are thickened at the ends, and furnished, like the shorter arms, with similar disks or suckers. The mouth of the animal consists of a powerful beak like that of a parrot. The eyes are large and prominent, and when the creature is alive and in vigour, are not only bright and staring, but have a look of intelligence and even of ferocity.

The singular appearance of this creature is accompanied by habits no less remarkable.

The members or limbs, already referred to, are used by it both as arms and legs. It walks at the bottom of the water with them, having its mouth and head downwards, and its body upwards; it also swims partly by these means, and employs them moreover in the capture of its prey, to which it attaches itself by means of the suckers before mentioned, which are furnished with muscles for creating a vacuum. As to its jaws or mandibles, they are a very formidable weapon, and can easily break open any species of crustaceans and shell-fish.

One would think that the soft body of the cuttle-fish would avail it little against the attack of a lobster with its formidable claws. There can be no doubt, however, that even a lobster is no match for a large cuttle-fish, naked and exposed although the latter appears to be. By means of its suckers it can easily tie together the pincers of the lobster so that they cannot open, and while its prey is thus rendered helpless, it can tear off with its beak-like jaws, as with a forceps, the crust in which its victim's body is encased.

On examining that part of the animal from which the head protrudes, a tube or funnel is discovered, which is connected with its branchiæ or breathing organs. To these organs the water is admitted, as it is admitted to the gills of fishes, but by a different apparatus. It gains access by valves which allow it to enter on the muscular dilatation of its body; and when the water so admitted has communicated its oxygen to the blood, it is expelled by the tube referred to; as in the case of fishes, it is driven out at the gills.

But the cuttle-fish is said to employ this funnel or tube for another purpose; for, by ejecting the water from it with force, it is, by the reaction of the surrounding medium, enabled to dart backward with amazing velocity out of the reach of danger. While, therefore, it swims forward with rapidity by means of the fin-like expansion of its tail, it possesses in the hydraulic apparatus now mentioned an additional organ of locomotion in a contrary direction. It thus appears that the apparatus adapted

primarily for breathing is applicable to an additional purpose under the impulse of instinct.

Another most remarkable peculiarity distinguishes the cuttle-fish. It is provided with an organ which secretes a black fluid by means of which it can darken the water so as to escape its pursuers.

This ink is said to yield the Chinese or Indian ink, so well known to artists. In Italy a similar ink, although not so black, is prepared from it, and Cuvier is known to have used it to colour the plates for his memoir of these animals.

It is interesting to add that the ink-bag having been found in a fossil state in the Bèlemnite, a kind of Cephalopod which has been entombed in the solid rock for countless ages, Dr. Buckland presented some of it to Chantrey, requesting him to ascertain its worth as a pigment, and a drawing having been made with it and shown to a celebrated artist, he pronounced the sepia to be excellent, and inquired by what colourman it was prepared.

There are several species of cuttles, each differing in some respect from the specimen now referred to.

There are two known as the nautilus, which inhabit shells, standing in relation to other cuttle-fish much as the hermit crab to the ordinary members of the crab world. Both these species have peculiarities of great interest.

The Paper Nautilus, or Argonaut, was long thought to sail by means of an apparatus which it is in the habit of

holding aloft, extending in a sail-like form. Possibly this apparatus does in a measure aid the creature's locomotive power, but its principal force is the *jet d'eau* which it ejects from its stern funnel, in common with all other fishes of its order.

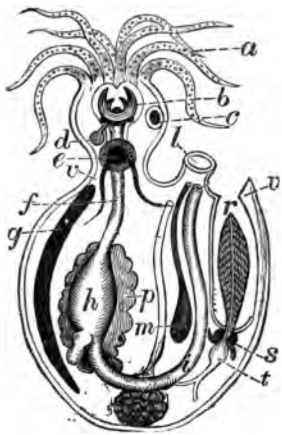



DIAGRAM OF CEPHALOPOD STRUCTURE.*

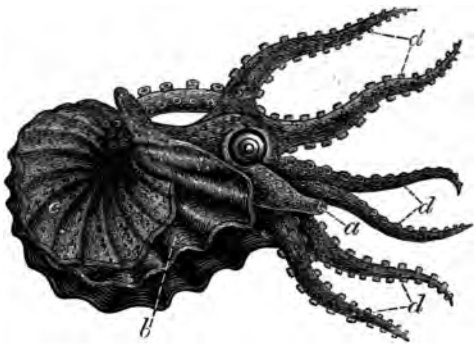
The Pearly Nautilus stands alone amongst cuttle-fishes in the number of its arms, in having no suckers attached to them, and being without the usual ink-sac, and in

* *a*, tentacles; *b*, horny jaws; *c*, eye; *d*, salivary gland; *e*, chief nervous centre; *f*, gullet; *g*, internal shell; *h*, stomach; *i*, intestine; *l*, funnel; *m*, ink-sac; *p*, liver; *r*, gill, enclosed in gill-chamber; *s*, gill-heart, driving venous blood to gill; *t*, systemic heart circulating blood through body; *v v*, mantle.

possessing, as an external covering, a large and many-chambered shell.

We cannot quit the subject without noticing a member of the family peculiar in form and habits even among the very peculiar race it belongs to.

Let us fancy ourselves to have met with one of these on the beach. It is low water, and the creature has been



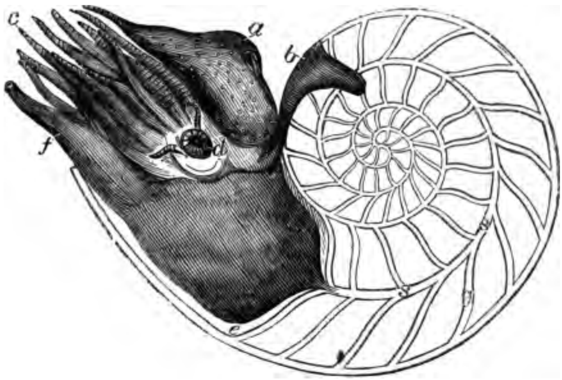

PAPER NAUTILUS, OR "PAPER SAILOR."*

left by the receding tide, but perhaps not unwillingly, for he is not only alive, but moving along in an inverted position, and although at a leisurely pace, indeed, still making some progress. This is the celebrated polypus of the ancients, and is called the Octopus, from its eight feet,

* (*Argonauta Argo*) *a*, funnel; *b*, shell, around which the two expanded arms (one of which is marked *c*) are generally folded; *d d d*, ordinary arms or feet; *e*, point towards which the Argonaut is supposed to be swimming.

or the common Poulpe. The body of this creature is almost globular; it is furnished with eight feet or arms, each having two hundred and forty suckers arranged in a double series. It is without the two long arms possessed by its relative the cuttle-fish; but it can walk with comparative facility, and in the water it can swim rapidly backwards.

This animal, with its staring eyes and uncouth shape,




PEARLY NAUTILUS (with shell in section).*

is undoubtedly of a very repulsive aspect, and must not a little terrify the unhappy creatures it pursues and seizes upon with its suckers. The ferocity of its look is doubtless an accurate index of the fierceness of its disposition.

* (*Nautilus Pompilius*) *a*, *b*, "mantle;" *c*, tentacles or feet; *d*, eye; *e*, last or body-chamber of the shell; *f*, funnel; *g*, one of the partitions of the shell.

This is illustrated by the following anecdote, which, although referring to a foreign member of the poulpe family, may perhaps indicate the character of our native species.

In his account of the "Natural History of the Sperm Whale," Mr. Beale mentions that on one occasion, while engaged in collecting specimens of shells on the shores of the Bonin islands, he encountered a most extraordinary animal, which was crawling on the rocks towards the water. It was creeping on its eight legs, which being soft and flexible bent under the weight of its body, and served indeed to raise it only a little from the surface along which it was moving. It seemed alarmed, and made great efforts to escape, but the naturalist had no idea of consenting to the termination of so unexpected an interview with the odd-looking stranger.

In his first attempt to prevent its escape he placed his foot upon one of its legs, but so great was its strength, that although he pressed upon it with considerable force, it easily liberated itself. Determined, however, to secure his prize as a remarkable specimen of its class, he then seized one of the legs in his hand, when the animal struggled with such vigour that it seemed as if the limb would be torn off in the contest. The animal in the meantime held itself fast to the rock by its suckers, and Mr. Beale gave it a sudden jerk to disengage it.

This seemed to excite it into fury, and after successfully resisting the attempt it suddenly let go its hold of the rock and sprung on its assailant's arm, which was bare,

and fixing itself by its suckers endeavoured to attack him with its powerful beak.

The sensation of horror caused by this unexpected assault may be readily imagined. Mr. Beale states, that the cold and slimy grasp of the ferocious animal induced a sensation extremely sickening, and he found it requisite to call to the captain, who was occupied in gathering shells at a little distance.

Mr. Beale, aided by his friend, then made his way to the boat, and the poulpe was at last destroyed with the boat-knife, but it did not surrender, till the limbs by which it so tenaciously adhered were successively cut off. The body of this cephalopod was not larger than a man's fist, but it measured four feet across its extended arms.

In the tropical seas the poulpe is said to arrive at an enormous size.

Mr. Pennant, on the authority of a friend long resident among the Indian islands, and who was a diligent observer of nature, states that the natives affirm that some have been seen two fathoms broad over their centre, and each arm nine fathoms in length.

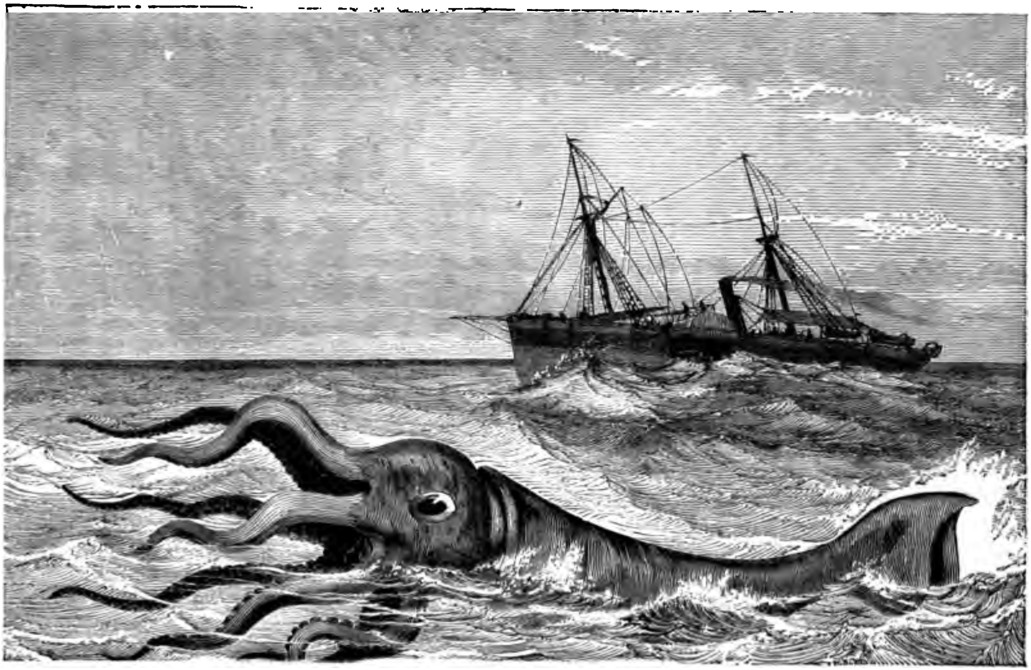
It is also well known that the Indians, when navigating their little boats, are in great dread of those frightful monsters, and always provide themselves with an axe to cut off their arms, which, if thrown across their boats, would throw them into imminent danger. The pearl divers, too, are said to be sometimes seized by these monsters of the deep, from whose grasp, under such circumstances, there is no release.

Possibly the account given by Mr. Pennant's friend may have been exaggerated by the terrors of the Indians who are his informants; but beside the general fact that the tropical seas nourish creatures of far greater magnitude than those of temperate latitudes, authentic instances are recorded, in which the octopus has actually been found of great size.

During Cook's first voyage the carcass of one was discovered floating in the sea, surrounded by aquatic birds, which were feeding upon it, and having examined the remains of this animal, which were deposited in the Museum of the Royal College of Surgeons, Professor Owen stated that its body must have been four feet in length, and its arms at least three feet more. There is, therefore, the highest probability that the tropical seas are inhabited by monsters of far greater magnitude of the same species.

Dr. Shaw thus speaks on the subject: "The existence of some enormously large species of the cuttle-fish tribe in the Indian northern seas can hardly be doubted; and though some accounts may have been much exaggerated, yet there is sufficient cause for believing that such species may very far surpass all that are generally observed about the coasts of European seas.

"A northern navigator, of the name of Dens, is said to have lost three of his men in the African seas by a monster of this kind, which unexpectedly made its appearance while they were employed, during a calm, in raking the sides of the vessel. The colossal fish seized



CUTTLE-FISH IN INDIAN OCEAN.

the three men in its arms, and drew them under water in spite of every effort to preserve them: the thickness of one of the arms, which was cut off in the contest, was that of a mizen-mast, and the suckers, of the size of pot-lids."

A variety of statements have been made in different places, and at various periods, all tending to strengthen the belief that such enormous octopods exist, and it is not easy to avoid concurring in the opinion of a celebrated naturalist, who has discussed the subject with great

EGGS OF THE CUTTLE-FISH.

ability, that the different authorities who have referred to it "are sufficient to establish the existence of an enormous inhabitant of the deep,—a cuttle-fish possessed of characters which in a remarkable degree distinguish it from every other creature with which we are familiar;" and further, that it would be "contrary to an enlightened philosophy to reject as spurious the history of an animal, the existence of which is rendered so probable by evidence deduced from the prevailing belief of different tribes of

mankind, whose opinions, it is evident, could not have been influenced or affected by the traditions of each other, but must have resulted from the occasional appearances of the monster itself in different quarters of the globe."

The eggs of the cuttle-fish are almost as remarkable as the animal itself. They are oval, or rather spindle-shaped bodies, about the size of grapes, and somewhat like them in colour; one end of each egg is furnished with a fleshy stalk, and the other is prolonged to a nipple-shaped point, and the skin is tough like india-rubber. By means of the stalk the egg is attached to branches of sea-weed, and numbers of them united to the same substance form a cluster by no means unlike a bunch of grapes, and appearing to an observer unacquainted with their real character to be some species of sea plant.

These eggs or bladders contain at first a yolk of a white colour enclosed in transparent albumen, but as it advances toward maturity the contents assume the form of the young cuttle-fish, which is at length excluded, like the chick from the shell, by the opening of the envelope in which it is enclosed.

# THE INHABITANTS OF THE DEEP.

## CHAPTER II.

### MEDUSÆ—VARIOUS.

STRANGE indeed are the creatures which naturalists term Acalephæ,—the Greek word for nettles—a title they have merited from their power of stinging; yet they do not less deserve to be called the fairies of the deep. They are also known as Medusæ, and popularly as jelly-fish.

It is impossible to contemplate these creatures without surprise. Their bodies are frail in the extreme. They appear to be no more than a mass of jelly. Yet that jelly is animated.

The property of emitting light which many of the acalephæ possess—the power of stinging seated even in the finest of their thread-like tentacula, and the wonderful digestive powers by which their stomachs quickly dissolve

fish and even crustacea—all afford matter of surprise. On this subject an excellent writer thus expresses himself:—"Our admiration of the various functions performed by the jelly-fish is much increased when we reflect upon the extremely small quantity of solid matter which enters into their composition.

"This fact admits of easy illustration.

"On one occasion I took a dead cydippe, and placing

SECTION OF COMMON JELLY-FISH.

it on a piece of glass, exposed it to the sun. As the moisture evaporated, the different parts appeared as if confusedly painted on the glass, and when it was become perfectly dry, a touch removed the only vestiges of what had been so lately a graceful and animated being."

Those visitors of the sea-shore who indulge in the pleasures of boating must frequently have observed and

admired the frail but beautiful globular transparencies, and beheld with delight their graceful movements as they impelled themselves through the water, by the alternate umbrella-like contraction and expansion of their bodies: now mounting through the clear water to the surface, now descending slowly downwards to the depths below.

The order of the Acalephæ comprehends a great variety of species.

Some are so minute as to be invisible to the naked eye, and can only be seen by the aid of the microscope; others have a diameter of two or three feet.

The forms of some are hemispherical, of others orbicular. Some are seen adorned with long tentacula, which stream behind them in the water; others, again, have no such appendages.

Their mode of locomotion is also various. By means of contracting its disk, one species propels itself through the water; by aid of small paddles placed on the circumference of the disk, another species urges its way onward.

They differ also in colour. Some are singularly beautiful, exhibiting those symmetrical patterns produced by the kaleidoscope; some are brown in the centre with sixteen lines pointing like radii to the circumference; some have a light purple cross in the middle, between each bar of which is a horse-shoe mark of a similar, though much deeper, hue, and from the circumference diverge rays of the same tint, but lighter than the rest.

Others, again, have a white cross, with a black spot on each of its arms, and others have a disk almost as translucent as the water in which they float, but in its centre is a bright crimson spot, like a piece of cornelian encased in crystal.

The hues of others are still more beautiful, though they are extremely minute. Of one of these last, whose tints are white and crimson, the late Professor Forbes thus speaks:—

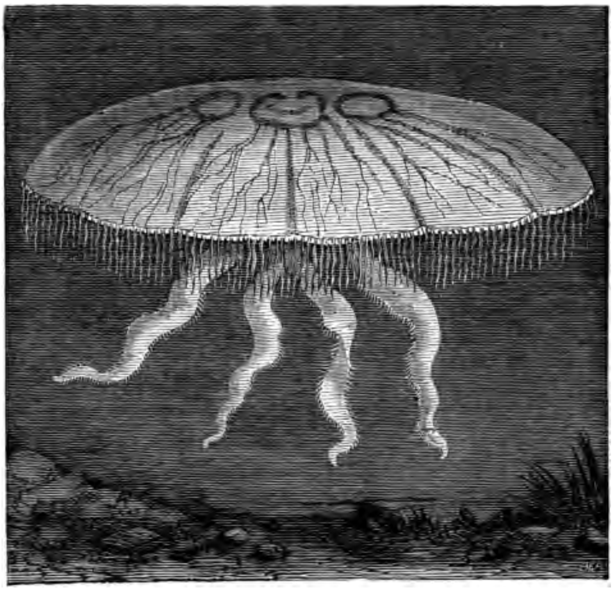
"There is not a medusa in all the ocean which can match for beauty with the minute creature now before us, though its smallness is such that a split pea would overtop it; yet, small though it be, it has shape, colour, and substance, so disposed that as yet no explorer of the sea has met with another like it. It is gorgeous enough to be the diadem of sea fairies, and sufficiently graceful to be the nightcap of the tiniest and prettiest of mermaidens."

These singular and interesting creatures are to be found in immense multitudes floating in all our seas.

Some of them, as already stated, have the power of stinging when handled. This property, however, belongs only to a few of those that inhabit our coasts. The medusa most remarkable for the possession of this power, this weapon of defence, is the *Cyanea capillata*, or hairy cyanea. Contact with it produces a burning sensation, similar to that caused by the sting of the common nettle. And the swimmer knows this to his cost when he chances to come in contact with this creature, as it marks his

body with long red lines, like the cut of a thin whip, causing considerable pain and feverishness.

The crimson-ringed jelly-fish is common, and must have been seen by all frequenters of the coast, either



PATTERNED AND FRINGED MEDUSÆ.

lying helpless on the beach, or floating at sea. Its disk is festooned with an immense number of tentacula of various lengths, that extend behind it as it flaps along beneath the surface.

The acalephæ, as already mentioned, have the power of emitting light.

In the seas of warmer latitudes this power produces an effect so striking, that the most eloquent description is insufficient to do justice to it. So innumerable are these medusæ in tropical waters, that the points of light they emit illuminate the whole surface of the midnight deep.

Under such circumstances, the scene from on board ship has a magical effect. As the vessel urges her way through the waters where these *sea lamps* hang suspended, the consequent agitation of the waters excites their illuminating powers into greater activity, and she is surrounded not only with innumerable sparks of phosphorescent fire, but broad flashes of light run along the top of every surge that strikes her sides, while globes of fire are seen just below the surface, produced by the larger jelly-fish.

If during a dark night one could descend a few fathoms below the surface, the appearance on looking upwards would be beautiful in the extreme, presenting, in the orbs of greater or lesser magnitude scintillating in countless galaxies overhead, much the aspect of the heavens on a starry night, fretted with golden fires.

In our own seas similar phenomena occur, though much less brilliant in character.

Few occupations are more delightful to the naturalist in rowing along some romantic shore, than to watch in the deepening twilight the phosphorescent radiance of the larger acalephæ, as the boat glides silently past them, and to admire the shower of sparks that fall from the

oars at every stroke, produced by the microscopic animals of the same kind.

Acalephæ are distinguished from each other by their mode of swimming. This some effect, as has been stated, by the sudden contraction of their mushroom-shaped bodies, which thus strike the water with their under parts, and propel themselves forward. This movement, easily perceptible in smooth water, has a sort of resemblance to the action of breathing performed by the lungs.

Others progress, not by alternate contraction and expansion, but by means of the cilia that fringe their bodies. These minute and innumerable cilia or hairs strike the water like a set of oars, ranged in rows along the outside of the living machine; and thus propel it through the deep.

One of the members of this class, of most fascinating aspect, is known to naturalists by the name Beroë.

The Beroë is from half an inch to about an inch in length; its body is pellucid; in shape it is like a nutmeg. Its body is subdivided by eight equidistant bands or ridges, much in the same way that a terrestrial globe is subdivided by the lines from south to north marking the longitude. Depending from the body are two tentacula, five or six inches in length, and furnished with a number of slender fibres like tendrils, all of which this fairy-like creature can at will draw up within its body. With these long tentacula it either secures its prey, or attaches itself to some point of support.

The locomotive machinery of this little medusa is even still more worthy of admiration than its singular beauty.

A minute examination of the bands or ridges already mentioned exhibits the extraordinary fact, that on the surface of each of them are a multitude of flat plates,

BEROE AND YOUNG MEDUSÆ.

formed by hairs or cilia, with their edges placed together like the plume of a feather. These paddles the Beroë puts in motion, and the power is sufficient to propel its orbicular body through the yielding water.

But what is still more noteworthy, not only can the Beroë thus move forward, but by reversing the motion of these living paddles, it can move backwards, and by using those on one side only it can turn round.

"Man justly boasts his steamboat," says Professor Jones, "and with pride points to those paddle-wheels with which he walks upon the waves. The paddle-wheels are here more perfect far than ever were contrived by human ingenuity, for all the cumbrous engineering required by man to urge their movements is not needed; each float, self-moving, keeping time with all the rest."

This wonderful creature, endowed with so marvellous and complicated a mechanism, is nevertheless amazingly simple in structure, so far as appearance would lead us to suppose; it is so translucent, that during day it is visible only by the iridescent hues shot forth from its paddles as they strike the water; and in darkness it shines with a blue phosphoric light, reminding one of a bubble inhabited by some sea-fairy, whose diadem glows through the fragile covering in which she is encased.

# THE INHABITANTS OF THE DEEP.

## CHAPTER III.

### MEDUSÆ; PORTUGUESE MAN-OF-WAR, ETC.

ANOTHER curious and beautiful species of Medusæ is furnished with a kind of air bladder by means of which it moves in the deep, or floats upon the surface. The well-known Physalia, or Portuguese man-of-war, is an example of this order. Though it can hardly be considered one of our native species, yet it is occasionally found on the shores of the south of England and Ireland.

On this curious creature, Mr. Gosse says:—

"The naturalist who has occasion to make a voyage over the warmer regions of the ocean is continually delighted by the sight of numberless forms of animals. Perhaps there is scarcely any that takes a stronger hold on the fancy, certainly none is more familiar, than a little thing that he daily marks floating in the sunlit waves, as the

ship glides swiftly by, which the sailors tell him is the Portuguese man-of-war. At a little distance it might well be mistaken for a child's mimic-ship, shining in all the gaudy painting in which it came out of the toy-shop; and he is ready to pity the forlorn urchin in tunic and knickerbockers, whose cherished boat has broken her moorings of thread, and drifted with winds and tides far, far out of reach of land.

"Not unfrequently does one of the tiny vessels come so close alongside that by means of the ship's bucket, with a little assistance from a smart fellow who has jumped into the 'chains' with a boat-hook, it is captured, and brought on deck. A dozen voices warn you by no means to touch it, for well the experienced seaman knows its terrific powers of defence.

"It does not now appear so like a ship as when it was at a distance. It is an oblong bladder of tough membrane, varying considerably in shape, and also in size, from less than an inch in length to the size of a man's hat.

"Once, in a voyage to Mobile, when rounding the Florida Reef, I was nearly a whole day passing through a fleet of these little Portuguese men-of-war, which studded the smooth sea as far as the eye could reach, and must have extended for many miles. These were of all sizes, within the limits I have mentioned."

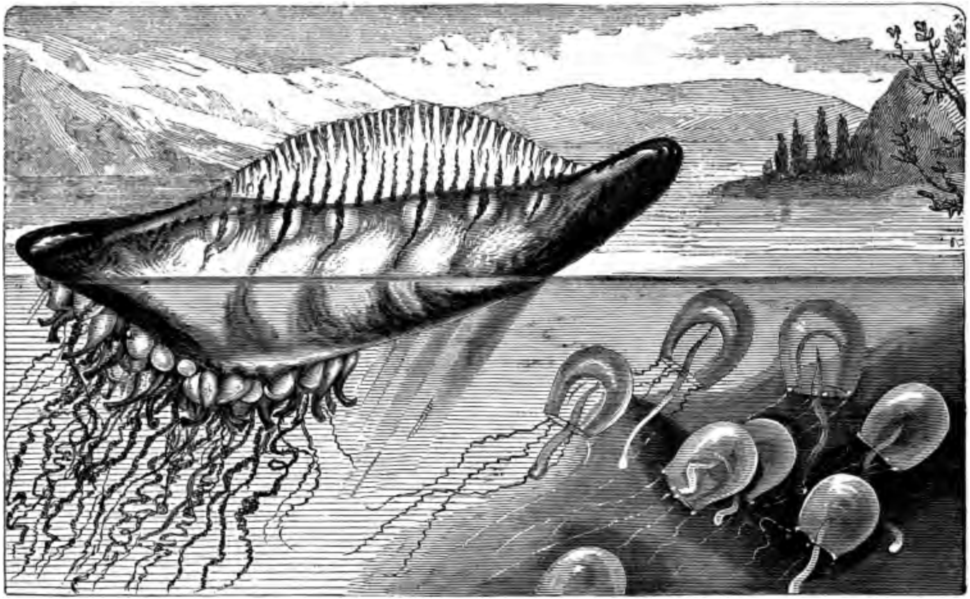
The bladder is filled with air, and therefore floats almost wholly on the surface. Along the upper side, nearly from end to end, runs a ridge of thin membrane,

which is capable of being erected at the will of the animal to a considerable height, when it represents an arched fore-and-aft sail, the bladder being the hull. From the bottom of the bladder, near the thickest extremity, where there is a denser portion of the membrane, depends a crowded mass of organs, most of which take the form of very slender and movable threads which hang down into the deep to a depth of many feet, or even, occasionally, of several yards.

The colours of this curious creature are very vivid; the bladder, though in some parts transparent and colourless, and in some specimens almost entirely so, is in general painted with the richest blues and purples, mingled with green and crimson to some less extent, and for the most part possessing great depth and fulness. The sail-like erectile membrane is transparent, tinted towards the edge with a lovely rose-pink hue, the colours arranged in a peculiar fringe-like manner.

Most formidable are the powers which reside in the long tentacles. Each of these is an excessively slender ribbon, similar to those of our sea-anemones, but of far more deadly virulence. Mr. Bennett, who for the sake of science ventured to test their powers, has left us a terrific account of his sufferings.

"On one occasion," he says, "I tried the experiment of its stinging powers upon myself, intentionally, when, on seizing it by the bladder portion, it raised the long cables, and entwining the slender appendages about my hand and finger, inflicted severe and peculiarly pungent



PORTUGUESE MAN-OF-WAR.

O

pain, adhering most tenaciously at the same time, so as to be extremely difficult of removal. The stinging continued during the whole time that the minutest portion of the tentacula remained adherent to the skin. The pain extended upwards along the arm, increasing not only in extent, but in severity, and could only be compared to a severe rheumatic attack; the pulse was accelerated, and a feverish state of the whole system was produced; the muscles of the chest even were affected, the same distressing pain felt on taking a full respiration as obtains in a case of acute rheumatism.

"The effects were very severe, continuing for nearly three-quarters of an hour. For some hours afterwards the skin displayed white elevations, or wheals, on the parts stung, similar to those usually seen resulting from the poison of the stinging-nettle.

"They seize and benumb small fishes by means of the tentacles, which are alternately contracted to half-an-inch, and then shot out with amazing velocity to a length of several feet. When seized, they drag the helpless and entangled prey to the sucker-like mouths."

That wonderful river that flows with a well-defined course through the midst of the Atlantic—the Gulf-stream—brings on its warm waters many of the denizens of the tropical seas, and wafts them to the shores on which its waves impinge. Hence it is that so many of the proper pelagic creatures are from time to time observed on the coasts of Cornwall and Devon. The Portuguese man-of-war is among them, sometimes paying

its visits in fleets, more commonly in single stranded hulks.

Another of the Medusa tribe, of which the Velella is an example, sails on the surface of the sea, and may be found in multitudes on our south-western shores during summer and autumn. It has a flattish oblong body, which, although membranous and fleshy, is transparent, and is tinged with dark blue spots.

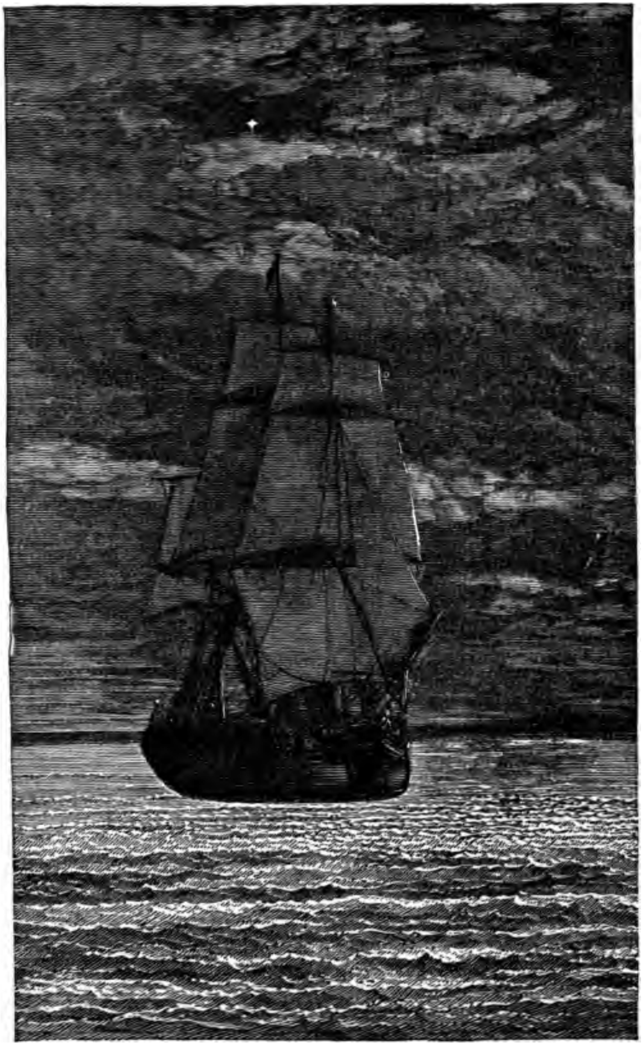
It is distinguished from any of the preceding species by the possession of a sort of skeleton or framework, also transparent, and of a horny texture, furnished with a plate, which, when the animal comes to the surface, serves as a sail, by which it is wafted onward. And more wonderful still, by means of long blue appendages which hang downwards from its body, this animated skiff can row itself onward, in the absence of a breeze, or steer when going before the wind!

Referring to those beautiful and delicate organisms, the poet justly exclaims—

> "Figured by hand divine, there's not a gem
> Wrought by man's art to be compared with them;
> Soft, brilliant, tender through the wave they glow,
> And make the moonbeam brighter where they flow."

On the subject of the luminosity of the sea, Professor Rymer Jones thus eloquently expresses himself, speaking of the phenomenon as witnessed by himself in the Mediterranean:—

"The light is not constant, but only emitted when



PHOSPHORESCENT SEA (NIGHT).

agitation of any kind disturbs the microscopic medusæ which crowd the surface of the ocean; a passing breeze, as it sweeps over the tranquil bosom of the sea, will call from the waves a flash of brilliancy which may be traced for miles; the wake of a ship is marked by a long track of splendour; the oars of your boat are raised dripping with living diamonds; and if a little of the water be taken up in the palm of the hand and gently agitated, luminous points are perceptibly diffused through it, which emanate from innumerable little acalephæ, scarcely perceptible without the assistance of a microscope.

"All, however, are not equally minute; the Beroës, in which the cilia would seem to be vividly phosphorescent, are of considerable size, and the *Cestum Veneris*, as it glides along, has the appearance of an undulating ribbon of flame several feet in length. Many of the larger forms shine with such dazzling brightness, that they have been described by navigators as resembling 'white-hot shot,' visible at some depth beneath the surface."

It appears that the young are produced thus:—The medusa gives birth to a multitude of minute bodies, gelatinous like itself, and in shape somewhat oval, like the seeds or sporules of some of the sea-weeds, and clothed with cilia, or hairs, that by their vibration propel them through the water (see page 187).

These buds, as they have been appropriately called, after a little while fix themselves to some stationary object, and soon undergo a rapid transformation. The body, instead of retaining its oval form, becomes elon-

gated, growing like a plant from the point by which it is attached, increasing in width at its upper extremity. In this upper extremity a mouth is soon formed, surrounded by four prominences that soon become long tentacula, like those of the sea anemones.

When this process has reached a certain stage of maturity, the young medusæ begin to be formed. Their earliest appearance is detected in the series of cups into which what may be termed the stalk of this plant-like creature is divided. These cups are placed one within another, and have their edges divided into lobes.

At length, in each of these cups an independent life is developed. The upper one separates from the rest, and immediately begins to swim about by means of the alternate contraction and dilation peculiar to the parent medusa. The second hemisphere soon follows the first, like ripe fruit from the stem on which it grew. And so the process goes on. In succession the juvenile jelly-fishes set forth on their voyage through the waters, as soap bubbles blown from a pipe wander through the air.

# THE FLOOR OF THE DEEP.

# THE FLOOR OF THE DEEP.

## CHAPTER I.

### ITS DEPTH AND FORM.

THE deepest places of the earth are not the valleys as seen from lofty mountain peaks. They are the unseen valleys of the ocean.

Nor is the variety of hill and plateau, ravine and mountain range, peculiar to the world's dry land. Though its surface is marked on the map as one monotonous level, the floor of the deep presents all the variety of form which characterizes the grandest landscape; its mountains rising to more sublime heights, its valleys sinking to more abysmal depths!

What their depth is, what untold wonders and inexplicable mysteries the abysses of the sea contain, have always afforded a subject of speculation.

It is scarcely possible to look on the calm surface of

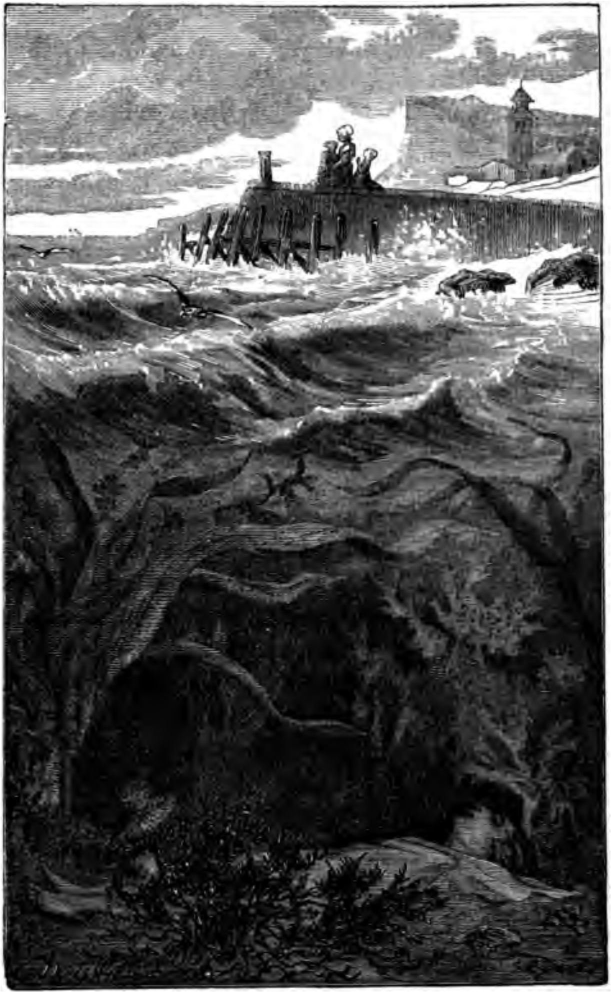
the deep, and think of the marvels and the mysteries which lie beneath, without emotions akin to those with which the devout astronomer, in the stillness of the night, contemplates the starry heavens, and thinks of the mysterious worlds they contain, their number, their magnitude, their grandeur! And the questions that suggest themselves as to their probable inhabitants, their physical forms and intellectual powers, their degrees of knowledge, the length of their lives, and the many similar questions that force themselves upon the astronomer's imagination, find many correspondents in the mind of the intelligent observer of the deep.

And there is, in fact, much that is analogous in the degree of success which has attended human efforts to penetrate the mysteries of the ocean depths, and to investigate those which belong to the inconceivably remote objects of the firmament.

But beyond the great natural wonders buried in the deep, what treasures of merchandise, what objects of love have found in it their grave! There lie the mighty ships of Tarshish and of every land! There lie the products of every clime, growths of nature, works of art! There, too, beneath its waving weeds, sleep the sailor and the fisher,—

> "For whom the place was kept at board and hearth so long."

Along all its heights, in all its valleys, whitening all its plains, are scattered all that hearts and homes have lost in the deep's ten thousand storms.

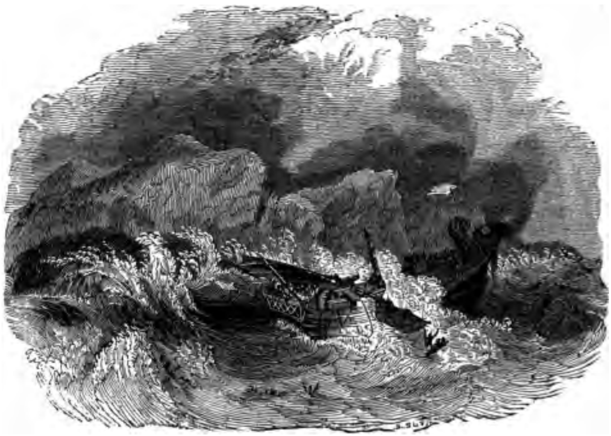


THE TREASURES OF THE DEEP.

"To them the love of woman hath gone down,
Dark roll their waves o'er manhood's noble head,
O'er youth's bright locks, and beauty's flowing crown;
Yet shall they hear a voice, 'Restore the dead.'"

The depth of the sea is a subject of vast interest, and on which modern research has cast considerable light.

The soundings taken in the Mediterranean prove that



SHIP FOUNDERING AT SEA.

sea to be of enormous depth. In the Straits of Gibraltar, where the passage is narrowest, there is a depth of five hundred fathoms.* Between Gibraltar and Ceuta, Captain Smyth found a depth of nine hundred and fifty fathoms. At Nice, within a short distance from shore, Saussure found the water to be two thousand feet deep,

* A fathom is six feet.

and M. Berard, in another place, could not reach the bottom with a line of six thousand feet.

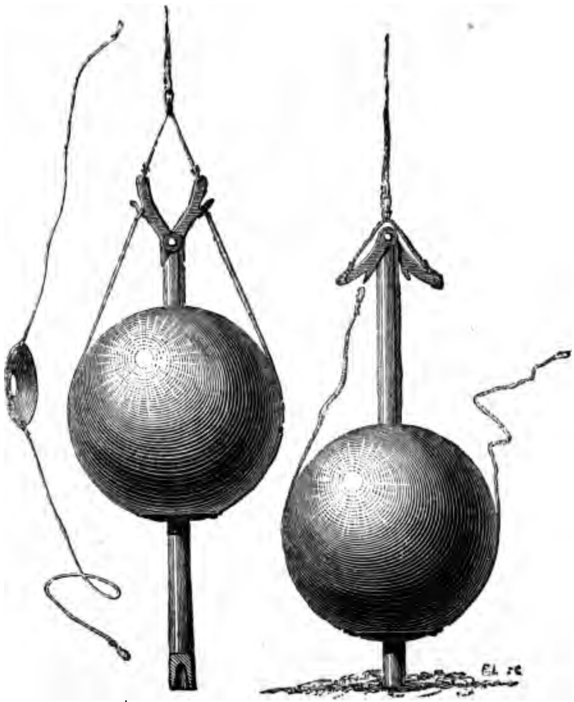
Lyell and others express the opinion that the central abysses of the Mediterranean are at least as deep as the Alps are high; but this is only a conjecture.

Within the last few years great depths, in some parts of the ocean, have been sounded, and specimens of the soil at the bottom have been obtained.

By means of a simple line attached to a heavy cannon-ball, Captain Denham, of H.M. ship *Herald*, sounded the Atlantic half-way between Buenos Ayres and Tristan d'Acunha, finding its depth to be eight and three-quarters English miles. A very interesting fact is brought to light by the observations made at the time. The first hundred fathoms of the plummet-line ran out in a minute and a half; the second hundred in two minutes, five seconds; the third, and every succeeding hundred fathoms, increasing in the time it occupied. The time occupied by the running out of the first thousand fathoms was twenty-seven minutes fifteen seconds; but the time occupied by the seventh thousand was one hour, forty-nine minutes, and fifteen seconds. The total number of fathoms run off was seven thousand, seven hundred and six, and the time occupied in the running off was nine hours and twenty-five minutes.

Lieutenant Parker, of the U.S. frigate *Congress*, in the South Atlantic, let go his plummet, and saw it run out fifty thousand feet without apparently touching the bottom. Lieutenant Walsh, of the U.S. schooner *Taney*, attempted

unsuccessfully to find the bottom of the ocean with a line thirty-four thousand feet long, and Lieutenant




BROOK'S APPARATUS FOR SOUNDING IN DEEP SEAS.

Berryman reported another unsuccessful effort of the same kind on a sounding line measuring thirty-nine thousand

feet. In the North Atlantic the greatest depth to which the sounding line has reached appears to be twenty-five thousand feet.

That the greatest depths of the ocean far exceed those measurements there is much reason to suppose; and although Laplace estimated the greatest depth at eleven, and Dr. Whewell at nine, it is probably as much as fourteen or fifteen miles.

# THE FLOOR OF THE DEEP.

## CHAPTER II.

### SUBSTANCE AND CHARACTER.

THE floor of the ocean! The mud of The Deep! Surely this is not a theme to interest!

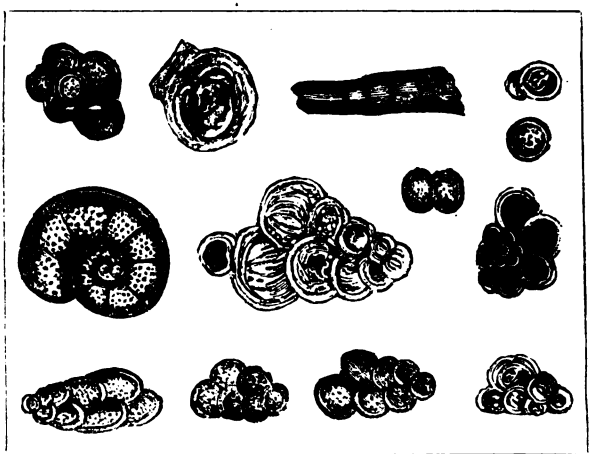
Let the reader not thus presume. There is a romance in ocean mud more wonderful and entrancing than fiction's wildest, happiest dreams.

The mud of the ocean is not mud, but a museum in which is stored, not softest soil, but minute organic forms, marvellous! countless! the "mortal coils" of beings whose antiquity is inconceivable.

Dr. Carpenter, on the Composition of the Deep Sea floor, says:—"It has been discovered to be chiefly composed of an aggregation either of very minute shells, or of the fragmentary remains of very minute shells, belonging to the group now called *Foraminifera* (the term

*Foraminifera* means many-holed ; and as these shells are pierced with multitudes of small holes, you will see that this name is very applicable to them) ; by far the greatest proportion being of the one type which we call *Globigerina*. Hundreds of them would only weigh a grain.

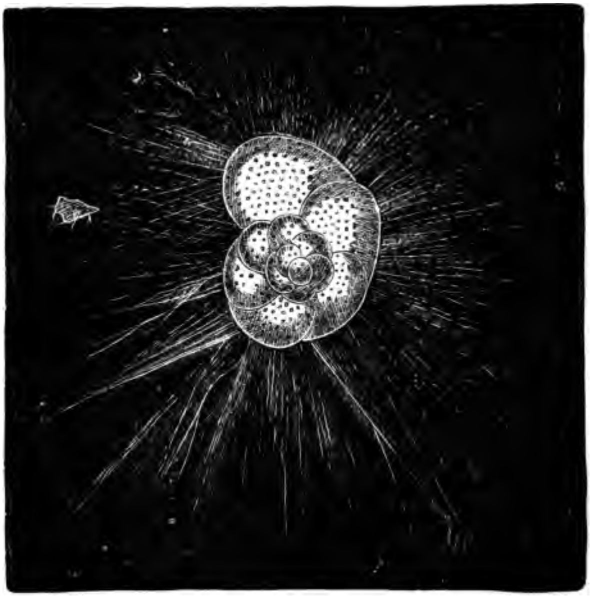
"What is the nature of the animal?



SHELLS OF FORAMINIFERA (Various).
Forming deep sea ooze. Greatly magnified.

"It is a little lump, or rather a series of lumps of jelly, with no mouth, no stomach, no anything, except that it can send out long threads, the minuteness of which is something hardly conceivable to you. These threads, which are not the ten-thousandth of an inch in diameter, go out in clusters ; they diffuse themselves through the

water, lay hold of particles still minuter than themselves, and then draw these particles back. I have sometimes described them as a sort of animated spider's web. The central mass is always sending out some of these threads, while other threads are being drawn back into it; and in

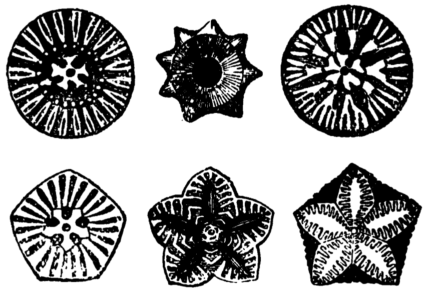


LIVING FORAMINIFERA (*Rotalia*).

With pseudopodia extended. Greatly magnified.

this manner, without any distinct mouth or stomach, the nutrient particles are constantly being drawn in, and the animal is thus supplied with food.

"A vast area of the bottom of the Atlantic is covered with these animals and with masses of their decayed and broken shells. I cannot pretend to form an estimate of how much there can be; but you may form some idea of it when I tell you that, in dredging the Atlantic at one mile in depth, though hundreds of them would weigh only a single grain, we brought up nearly half a ton at one time; and from nearly three miles' depth we brought up



SECTIONS OF MADREPORES.

one hundredweight and a half, besides our three miles of line and a heavy dredge."

So that the mud of the ocean is not uninteresting, neither is the character of the surface of the floor devoid of beauty. Speaking of one part of the floor of the deep, Canon Kingsley says:—

"You have seen the room in the British Museum, full of corals, madrepores, brainstones, corallines, and sea-ferns?

"Then fancy all those alive. Not as they are now, white stone, but covered in jelly; and out of every pore a little polype, like a flower, peeping out. Fancy them of every gaudy colour you choose. No bed of flowers, they say, can be more brilliant.

A SEA-SLUG.

"Fancy, again, growing among them and crawling over them, strange sea-anemones, shells, star-fish, sea-slugs, and sea-cucumbers with feathery gills, crabs and shrimps, and hundreds of other animals, all as strange in

shape, and as brilliant in colour. You may let your fancy run wild. Nothing so odd, nothing so gay, even entered your dreams, or a poet's, as you may find alive at the bottom of the sea, in the live flower-gardens of the sea-fairies."

"The rocks and grottoes of the ocean," says another observer, "are as richly carpeted with a verdure of their own, as our hills and valleys. Seaweeds and corallines, exquisite in colour and beautiful in form, clothe them in rich profusion. But though away from the view of man or of those animals with whom he is more familiar, there are creatures formed to revel in this luxuriant growth, and to whom it affords a continual banquet."

From Dr. C. Wyville Thomson's account of soundings taken in the celebrated voyage of the *Challenger*, between Teneriffe and St. Thomas, we extract the following simple, yet striking facts:—

"About three hundred miles to the west of Teneriffe we sounded in fifteen hundred fathoms, evidently on the top of a ridge. Here the dredge brought up some globigerina ooze, mixed with an infinite multitude of the shells, and along with it the broken and dead branches of a large coral resembling the red coral of the Mediterranean.

"Attached to the coral there were some splendid specimens of a sponge allied to the glass-rope sponge of Japan.

"From this fifteen-hundred-fathom crest the bottom again sloped down rapidly, reaching a depth of two thousand seven hundred fathoms at five hundred, and two thousand nine hundred and fifty at seven hundred

and fifty miles from Teneriffe. At the first of these dredgings several living shell-fish were brought up, but the most remarkable point was that with the increasing depth there was a gradual change in the character of the bottom, which became darker in colour.

"This change attains its maximum at a distance of eleven hundred and fifty miles from Teneriffe, where from a depth of three thousand one hundred and fifty fathoms, the dredge brought up a pure smooth red clay. The material of this deposit was in the finest possible state of subdivision—so fine that when after sifting it we put it into jars to settle, it remained for several days in suspension, giving the water very much the colour and appearance of chocolate, and only sinking down extremely slowly.

"Here there seems to be but little animal life, the only examples observed in this dredging being a few foraminifera, with their tests composed of the fine mud, looking when dried like miniature flasks of the finest terra-cotta.

"From this great depth the bottom gradually rose, and as it did so the grey colour and the calcareous composition of the ooze partially returned. Station 13 of our line, about half-way across, gave us a depth of nineteen hundred fathoms, with the ordinary globigerina ooze. This proved to be the summit of an elevation, named the 'Dolphin Rise.' It seems almost certain that it is an extension southwards of the elevated tract which divides the North Atlantic into an eastern and a western trough, rising into the plateau of the Azores and then continuing

northwards until it joins the shallow water belt which bounds the North Atlantic basin on the north.

"Here the dredge again brought up many animals, chiefly mollusca (*i.e.* soft bodied, like the cockle or oyster), and crustaceans (*i.e.* like the crab or shrimp).

"Among the latter was a large cray-fish of a delicate rose colour, with four very long antennæ and two long claws, extremely delicate and elegantly formed, the terminal nippers very delicate and of a pale pink-coral colour,

MOLLUSCA.

veined with red. The animal was perfectly blind—she is not only destitute of eyes, but of the eye-stalks, the first-paired appendages whose presence is a distinguishing peculiarity of her class. She is not, however, by any means alone in her blindness. Other crustaceans have now been recovered from the bottom of the deep sea in which organs of sight are absent, and one form, from the Mammoth Cave in Kentucky, is sightless, although morphologically the eyes are not entirely wanting, for two

small abortive eye-stalks remain in the position in which eyes are developed in all normal specimens. There can be little doubt that in all these cases blindness is due to the same cause, the absence of the stimulus of light."

The pressure exerted by the deep, at its great depth, is strikingly illustrated by Dr. Thomson's experiment with a beam of pine.

"At Station 14, a little farther on," says he, "a trawl with a twenty-two feet beam was sent down to a depth of nineteen hundred and fifty fathoms. The beam was of pine, not so strong or compact as the ash beam previously used, which was unfortunately lost among the volcanic ridges off Teneriffe. The trawl-beam came up broken through the middle, and so compressed that the knots stood out a quarter of an inch beyond the surface of softer parts of the wood. A piece of it thrown into water sank to the bottom like a stone. It is not surprising, therefore, that of ships of wood foundering in deep seas, not a particle should ever rise again to the surface; for even cork, subject to the pressure of deep sea water, becomes almost as heavy as lead. Even from a depth so great, and under such pressure, sea plants and sponges were found to be growing.

"From this point to within about two hundred miles of Sombrero the depth gradually increased to three thousand and twenty-five fathoms, and the mud resumed its red colour.

"The origin of this enormous deposit of red clay is, of course, a question of very special interest. In the

section from Teneriffe to Sombrero it occupies eighteen hundred out of the total two thousand eight hundred miles, and it extends doubtless far on either side of our line of section."

Again Dr. Thomson says :—"Throughout the whole of

TOP OF A LILY-STAR.

the mid-Atlantic the sea swarms with pelagic mollusca, and the shells of these are constantly mixed with the globigerina ooze, sometimes in sufficient number to make up a considerable proportion of its bulk.

"Again, we found in the deep sea some extremely

interesting *living* representatives of the *Crinoids* or Lily-stars, and some most singular specimens of the *Echinus*, or Sea-Urchin tribe.

"Nearly every haul gave us delicate branching Bryozoa, *i.e.* minute soft-bodied animals which live in masses, of a moss-like form. One fortunate cast, about one hundred

SEA-URCHIN, SHELLS, AND CORAL.

and fifty miles from Sombrero, brought up from a depth of two thousand nine hundred and seventy-five fathoms, very many of the tubes of a tube-building annelid, several of them three to four inches long, and containing the worms still living."

Speaking of the red clays of the ocean floor, Dr. Thomson says:—"One is inclined to suspect that they may be organic formations, accumulations of the insoluble 'ashes' of shelled creatures." And of the enormous length of time required for these beds to have thus formed, the same authority says,—"We vaguely attempt to express our sense of its immensity by speaking of such periods as tens or hundreds of millions of years."

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## Part I.

### CORALS, Etc.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## PART I.—CORALS, ETC.

## CHAPTER I.

### SEA-ANEMONE.

THE name zoophyte signifies animal-plant, and was given to a class of creatures because at one time they seemed to belong to neither the vegetable nor the animal kingdom. Though the kingdom to which many of these creatures belong is now determined, it is still convenient to retain their original names.

Ten thousand curiosities are found in their construction and habits.

Amongst the best-known of these are *Actiniæ*, or, in popular language, sea-anemones. They have fleshy bodies, of various hues and sizes, are attached to one spot, and

the tentacles which surround their mouths when expanded give them a striking resemblance to flowers. When the tide has receded, they may be seen attached to the sides of the rocks, beneath the overhanging sea-weed. Their appearance when thus discovered is by no means attractive. They resemble small hemispheres, or cones, in the centre of which is an orifice closed up, something like the mouth of a bag when tightly drawn together by the string. Those of a red colour are very similar to a piece of raw flesh, and, on being touched, the resemblance

ANEMONE—TENTACULA EXTENDED.

is still more striking, on account of the tough muscular sensation they convey.

Very different does the sea-anemone appear when the tide is in; it then puts on all its charms, and if the sea is clear and tranquil, and not too deep, may be seen in great perfection, expanding under the influence of the water, as the flower unfolds its petals to the sun. The cone-shaped mass of inert matter is now full of life and

activity; the tentaculæ, before concealed within the body of the animal, are now extended, reminding the beholder, by their form and colour, of some gay denizen of the garden; so much so, that where many of these creatures are found together, they resemble the parterre adorned with many-coloured blossoms.

A cultivated and passionate lover of Nature has thus described them:—

"When closed, the many tentacles being concealed, they look like balls, or hemispheres; or like ripe fruits, so plump, and succulent, and glossy, and high-coloured, that we are tempted to stretch forth the willing hand, to pluck and eat. Some are greengages, some Orleans plums, some magnum-bonums—so various are their rich hues; when opened out, their whole beauty revealed, they assume quite another guise. These are all widely expanded, the tentacles are thrown out in an arch over the circumference, leaving a broad flat disk; just like a many-petalled flower of gorgeous hues; indeed, we may fancy that here we see the blossoms, and there the ripened fruit."

Their names in many cases are the same as the flowers they are supposed to resemble, while others have appellations derived from some peculiarity of form or of colour. Thus we have the cereus, the daisy, the pink, the aster, the sunflower, the auricula, the gemmacea, &c.

A few of these will be here described, although no language can do justice to the beauty of these singular creatures, when seen to advantage in their native element.

The *Cereus*, frequently found on the Welsh coast, and also on the south-western shores of England, has its body marked with longitudinal furrows, or sulci. Its summit, when expanded, is furnished with slender tentacula, from a hundred and twenty to two hundred in number; the

BEADLET ANEMONE (Expanded).

body is of a pale chestnut colour, the tentacula of a sea-green, varied with purple.

The *daisy* anemone (*Actinia bellis*) is a remarkably beautiful species, also found on the south-western shores of England, and also in other localities. A cylindrical

stalk from one to three inches in length, and of a fine red colour, supports the disk or body.

When expanded, it exhibits a radiated surface or disk much larger, in comparison with the size of the body, than that of any other varieties. The surface of this disk

ORANGE DISK ANEMONE (Expanded and closed)

is covered by several hundred tentacula disposed in separate circles round the centre, from the outside of the disk to near its centre. These tentacula point outwards to the circumference of the circle, with the exception of

those forming the inner ring, which are elevated more or less from the plane of the disk.

These numerous feelers exhibit great variety of hue. In some they are dark brown, yellowish, ornamented with white spots, while the disk itself is tinted with grey, lilac, white, and is sometimes dark brown with scarlet lines diverging from the centre. This species is exceedingly like a beautiful flower.

Another remarkable kind is the *Actinia gemmacea.* It derives its name from the circumstance that it has its stalk or body marked with tubercles like gems, reaching from the base to the top. When contracted, it assumes the form of a bell with the mouth downwards, and the gem-like rows of tubercles converge in an elegant manner from the base to the closed aperture of the mouth.

The body is of a beautiful rose-colour. The rows of tubercles are alternately white and grey, the disk when expanded is variegated with different hues, green, white scarlet, black, while the tentacles are of a fine blue colour, and add much to the beauty of this "gem of the sea."

The actiniæ, although almost invariably found attached by their bases to the rocks, are understood by naturalists to be able to remove from one station to another. Their food consists of aquatic animals of all kinds; they swallow crabs and shell-fish, the hard and indigestible parts of which they afterwards disgorge.

Sea-anemones possess remarkable powers of bearing mutilation. If the tentacula are cut off, others speedily

take their place. If the body of the animal be cut into two parts lengthwise, each will become perfect, and two separate actinias will be the result. Even if all the original animal be destroyed except a minute fragment of the base, this fragment will be sufficient to originate a new and perfect specimen.

A very singular instance is related by an excellent naturalist of the marvellous manner in which this creature

THE GEMMED ANEMONE (Expanded and closed).

is enabled to accommodate itself to circumstances of the most apparently untoward character.

"I had once brought to me a specimen of the *Actinia gemmacea* that might have been originally two inches in diameter, and that had somehow contrived to swallow a shell of *Pecten maximus*, the common scallop, of the size of an ordinary saucer. The shell fixed within the stomach was so placed as to divide it completely into two

parts, so that the body, stretched tensely over, had become thin and flattened like a pancake.

"All communication between the inferior portion of the stomach and the mouth was of course prevented; yet, instead of emaciating and dying of atrophy, the animal had availed itself of what had undoubtedly been a very untoward accident, to increase its enjoyments and its chances of double fare. A new mouth, furnished with new rows of numerous tentacula, was opened up on what had been the base, and led to the under stomach!"

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## CHAPTER II.

### CORAL-BUILDERS.

AMONGST the curious sea-creatures which are called animals, yet grow like plants, known as zoophytes, none have a biography more interesting than the builders of coral.

They are sometimes called coral-insects, but they are not really insects, and are not at all like insects. Coral-polypes is the best name for them, because they have arms round their mouths. The animal which they are most like is the sea-anemone.

If you look at a piece of fresh coral, you will see that it is full of pipes; in each of those pipes has lived what we will call, for the time being, a tiny coral builder, joined on to his brothers by some sort of flesh and skin;

and all of them together have built up this coral house, or rather coral town.

Now fancy to yourself a bush branched like a hawthorn bush, with numberless blossoms on every branch, and every blossom a separate living thing, with its own mouth, and arms, and stomach, budding and growing fresh live branches and fresh live flowers, as fast as the old ones die, then you will see what is the character of these coral towns.

How wonderful!

On the floor of tropical seas are millions on millions of such towns, spreading for miles on miles, building up at last great reefs of rocks, and whole islands, which all grow rooted first to the rocks, like sea-weeds; and what is more, they grow, most of them, from one common root, branching again and again, and every branchlet bearing hundreds of living creatures, so that the whole creature is at once one creature and many creatures. Do you not understand me?

Specimens of the coral-building polypes of the tropical seas have sometimes been found in deep water off the shores of the British islands. They belong to the same order as the sea-anemones we have been referring to, but to a different family.

Such mighty structures have these tiny creatures reared in the Pacific, that compared with them the works of man are small. One single coral reef, for instance, lying off the eastern coast of New Holland is a thousand miles in length, and there are groups of coral islands extending more than twelve hundred miles, with a breadth of three

or four hundred. These are entirely constructed by those minute but indefatigable labourers, and afford one out of many other proofs of the magnitude of the effects which by the arrangements of Divine Providence are produced

BRANCHES OF CORAL AND CORALLINES.

in the natural world by agents individually feeble in the extreme, but possessing marvellous power when united in great numbers.

The organization of those apparently insignificant beings, and the instinct with which they are endowed, adapt them to perform, with a precision never exceeded by the most skilful chemist, one of the grandest operations of Nature's laboratory. The currents of the ocean bring to them in the sea-water a solution of carbonate of lime, washed by the rains and carried by the rivers of remote continents into the sea. This lime those little chemists separate from the sea-water, and form into a symmetrical structure as compact and solid as marble.

Myriads of them thus labouring without a moment's intermission day and night and year after year, are able to transform the dissolved lime contained in the waters of the deep into solid mountains on which the utmost force of the billows is spent in vain.

Of course the coral polypes cannot build above the high tide mark; but the surf which beats upon them piles up their broken fragments just as a sea-beach is piled up, and hammers them together with that water hammer which is heavier and stronger than any you have ever seen in a smith's forge. And then, as is the fashion of lime, the whole mass sets, and becomes hard, as you may see mortar set; and so you have a low island a few feet above the sea.

Then sea-birds come to it, and rest and build; and seeds are floated thither from far lands; and among them almost always the cocoa-nut, which loves to grow by the sea-shore, and groves of cocoa palms grow up upon the lonely isle. Then, perhaps, trees and bushes are drifted

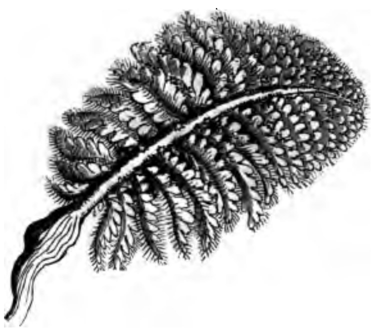
thither before the trade-wind; and entangled in their roots are seeds of other plants, and eggs or cocoons of insects; and so a few flowers and a few butterflies and beetles set up for themselves upon the new land. And then a bird or two, caught in a storm and blown away to

SERELLA TUBULARIA.

sea, find shelter in the cocoa-grove; and so a little new world is set up.

An hour or two spent in dredging for specimens in the deep water off the shore often supply many *Tubularia* and *Sertularia*, which comprehend a great many varieties

of species. Some of these may be found in such a rock-pool as we have been visiting, or attached to sea-weeds near low-water mark. The *Coryne Pusilla* is an object which ordinary industry may discover on almost any shore. It is found attached to stones and sea-weeds, and resembles a plant with its stem and branches. The ends of the branches are terminated by the heads of the



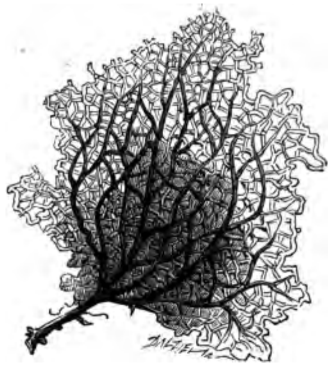
SEA-PEN.

zoophyte, which are fleshy and of a reddish colour, and covered with short and thick tentacula.

The Sertularia are also zoophytes. The specimen we pick up on some sea-weeds at low-water mark is a very common but elegant species. It is called *Sertularia filicula;* it resembles a fern in shape, having a middle stem from which pinnated branches (like the fronds of some species of ferns) proceed. These, and others of the same genera, are compound, and formed of a vast multi-

tude of individuals, a single specimen sometimes containing five or six thousand individual polypes, and some of the species known as *Sertularia argentea*, being formed of eighty or ninety thousand, all united together by the medullary substance or fibre contained in the branches.

Numerous specimens of this kind are often found fixed upon a single sea-weed, which would thus afford an



SEA-FAN.

abode to a population greatly more numerous than the most populous city in the world.

The Sea-Pen is by no means a rare object on many parts of our coast. It belongs to the family of polypes, and is compounded; consists of numerous individuals united, may often be met with, and is extremely remarkable. It is three or four inches in length, of a purplish-red colour, and fleshy in substance, and like a pen naked at one

extremity and feathered on the other, with closely-set pinnæ, on the edges of which are the cells of the polypes. The body of the common stalk and branches, or pinnæ, is calcareous, and thus possesses the requisite degree of strength. The sea-pen is phosphorescent, and when irritated or injured or thrown into fresh water the polypes shed a brilliant light.

The Sea-Fans are of the same order. One of the British species of sea-fans is common on the shores of Devonshire, and is called *Gorgonia verrucosa*. This species is from six to twelve inches in height, and much branched. On the surface of these branches, which are calcareous, like other corals, is a flesh-coloured crust, which is the living membrane in which the individual polypes reside.

A careful examination with a microscope of these creatures will amply repay the observer.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## CHAPTER III.

### SPONGE.

AMONGST the best-known curiosities of the ocean's floor is the common sponge.

At one time it was imagined that sponge was a vegetable growth, a sea plant. But modern discovery announces it to be an aggregation of the remains of tiny animals. The sponge we use is the skeleton of the original living sponge, and when living it was clothed with soft, fleshy bodies. These tiny bodies are furnished with long, thread-like fibres, known as cilia.

They inhabit all the cells and passages of the sponge, and by the action of these fine, thread-like fibres, they keep up the requisite circulation of water to maintain life,

to keep their dwelling clean, and to supply the materials with which they work.

These little animals have a great variety of habits and tastes—some live in our own seas, but the finest specimens are found in the regions of distant foreign lands. Some sponge-makers prefer to work to the pattern of a cup, others to that of a globe, and others, of a tree; whilst some prefer the shape of pipes, crosses, and trumpets.

They choose foundations of rock, branching coral, and sometimes, perhaps desiring to see the world, the back of some moving shell-fish. Dr. Johnson, in his "History of British Sponges," says that he once found one attached to the back of a living crab. Certain kinds of these minute creatures have the power to bore rocks which are hard enough to defy any but the very best mechanical contrivances; a power which, when convenient, they effectively exert. They flourish best where their position is exposed, and the sea rough.

Some sponges are not fit for domestic use, though well suited to add curiosity to a museum or ornament to a drawing-room. These have, beyond the fibrous elastic skeleton of the common house sponge, hard, brilliant, needle-point-like formations of mineral matter, called spicules. Others have no soft tissue at all, they consist entirely of a hard framework of singular beauty, six needle-points starting from one glistening centre, star-wise, and a heap of these being fixed together in fairy lightness.

Of this class is the famed "Venus's Flower-Basket." Its general form is indicated by its name. When full grown its expanded top is covered by a lid, around its bottom is a sort of fringe, with which it anchors itself to the rocks, the whole appearing like finely-spun glass. Its home is the Manilla seas.

Mr. Gosse, the naturalist, has described many of our British shore sponges. From these descriptions we extract the following fragments. The lens is brought to bear upon one of the yellow species, which throws up little hillocks,—the Crumb-of-bread Sponge:—

"Our attention is at once excited by seeing a strong movement in the water, through which tiny atoms are hurled along in swift currents. We fix our gaze on one of the hillocks:—lo! it is a volcano! From the perforate summit of the cone, as from an active crater, is vomited forth a strong and continuous stream of water, and crowds of atoms come pouring forth, disgorged in succession from the interior, and projected far away into the free water, to be followed by unintermitting crowds of others.

"This is highly curious, and we wonder what is the nature of the power which so strongly conveys to us the idea of an active vitality in a mass so inert and apparently lifeless as this yellow incrusting sponge.

"But let us apply the magnifying glass to another cell containing one of the bits of rock that has on it the cones of pellucid rosy lilac,—the Rosy Crumb Sponge.

"There is a general resemblance to the former in shape, as it is an incrusting kind, spreading over the

stone, and rising here and there into well-marked conical eminences, each of which is perforated with a large circular orifice. The colour somewhat varies, for while some specimens are of a fine red-purple hue, others are lilac, and others fading to almost white.

"As we look at our specimen through the magnifying lens, we fancy that the eye roams over an undulating country studded with pointed hills. But a peculiarity which at once strikes the observer, and to which there was nothing parallel in the former case, is, that the whole surface of this mountainous region is studded with tall and slender poles projecting from the ground, at various angles with the horizon, and frequently set in little groups. These poles or rods are drawn to a point, transparent, and seem made of glass.

"More unaccountable still,—we see a web of exceeding delicacy, far more delicate than the finest cambric, transparent and colourless, thrown over the entire hilly region. It appears to have been spread after the rods had been inserted, or else these have protruded from below, under the investing web; for though here and there the points have pierced through it, yet they have lifted it from the surface, and carried it partially with them, so that it hangs in crescentic veils from group to group.

"Here, as in the former case, a strong intestine motion is visible in the water to the unassisted eye. But it is far more forcible in this example than in the other."

In order to render the motion of the currents much more appreciable by the eye, Mr. Gosse rubs a little

carmine on a palette, and with a camel's-hair pencil diffuses carefully a small portion of the fluid pigment in the water surrounding the sponge, making it slightly dimmed with pink clouds.

SPONGE—ADHERING TO THE ROCK.

"It is beautiful now to see," says he, "how the water, loaded with the atoms of red pigment, is uniformly drawn

from all surrounding parts within a certain range towards each orifice, slowly and imperceptibly in the remoter parts of the circle, but ever acquiring more and more velocity, till it rolls up the sides of the hill, and then is shot away perpendicularly like a torrent of smoke and ashes from the crater of a vomiting volcano."

Speaking of the comparatively large body of water which is ejected from the crater-like orifices of the sponge, the same author says:—

"We shall find that the round apertures are the mouths of a few large canals which run through the interior; that into these open, at irregular intervals, other subordinate canals; that these receive others smaller still; these, again, others, in an ever-diminishing ratio; till at last we can no longer trace them as canals, the whole superficial portion of the sponge being pierced with microscopically minute and innumerable pores. Into these the external water is constantly being absorbed, carrying with it both oxygen for respiration, and organic matter for nutrition.

"The influent water, parting with these elements, and thus revivifying the living gelatinous flesh that clothes every fibre, gradually permeates the whole interior, flowing along the pipes in succession, till at length it gathers into the larger canals, and is poured out at their apertures, as we have seen; just as the waste water from every house of a large city falls down the sinks, and rolls through the smaller sewers till it reaches the main, and joins that of other houses, and is vomited forth at the

common outlet. Or it is like the rains and dews, which, falling noiselessly and unobtrusively over a great extent of country, collect in mountain springs, which feed the rivulets and brooks, and these in their turn unite into rivers, which open on the coast in a broad estuary, and send forth a volume of fresh water, whose current can be perceived for many miles in the open sea."

The sponge which we use for washing has a skeleton made up of fibres of horn, but those which Mr. Gosse has been describing have their solid parts made up of flint, the particles of which are arranged in needles (*spicula*) of a perfectly transparent, solid, brittle glass. These spicula, however, when the sponge is alive, are entirely covered with fleshy, gelatinous atoms. Having, with a needle-point, torn a piece of sponge away from the mass, and having, by a chemical solution, cleared off from it all its fleshy atoms, Mr. Gosse subjects it to the microscope.

"What a wilderness of brilliant starry points now meets the eye! An incalculable multitude of three-rayed stars is seen, as if three needles of glass had been united by their heads, so as to radiate at an angle of 120 degrees. There is no variation in the angle of radiation; all are exactly alike in this respect, though they differ much in the length and stoutness of the rays. It seems as if thousands upon thousands of such stars had been put into a box, and well shaken together, so as to be inextricably interlaced. Some seem, naturally enough, to have been injured by the shaking; for many a point

is broken short off, at varying distance from the diverging centre.

"Of course, this shaking together is only imaginary—only a homely comparison to help description; the real explanation of the entanglement doubtless is, that they have been deposited by the living flesh, atom after atom, in succession, and that the points of the newly-formed have shot between and among the interstices of the already existing ones, producing such a tangle that it would probably be impossible, even with pliers ever so fine, to extract one from the mass, without breaking either itself or some of its fellows.

"I hope some of my readers may be interested in these attempts to describe atoms that are among the meanest things which God has made. I say 'attempts to describe' rather than 'descriptions;' for as I gaze at the wondrous array of starry spicula actually spread out on my microscopic stage, on the table where I am writing this paper, at this moment, I feel how inadequate are words to grasp the inconceivable perfection and glory of the Divine handiwork!"

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## Part II.

### STAR-FISHES.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## PART II.—STAR-FISHES.

## CHAPTER I.

### STAR-FISHES PROPER.

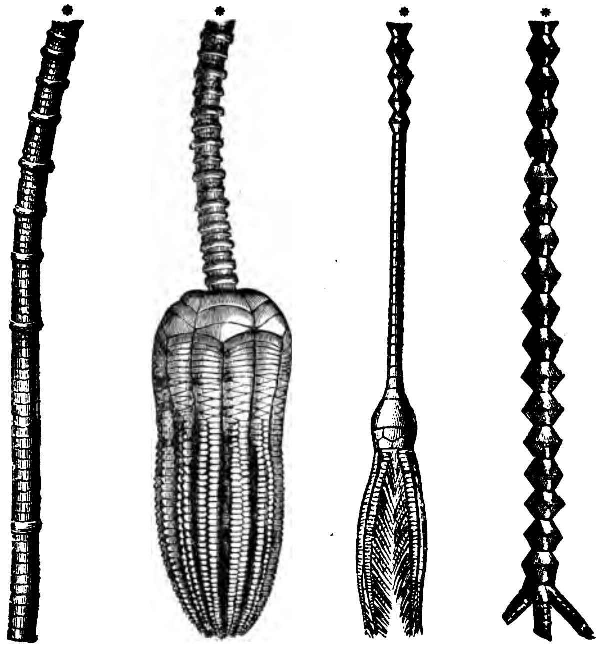
THE star-fish differs in a striking manner from every other inhabitant of the deep, alike in peculiarities of structure and in habits of life.

Star-fishes are known to naturalists as the *Echinodermata*, *echinus* being the Greek word for hedgehog, and *derma* meaning in the same language a covering. The class comprehends all those rayed animals which are enveloped in a covering, either hard or rough, or beset with prickles, like the hedgehog.

The various species of star-fishes differ widely from each other.

The whole order has been subdivided by naturalists into six families.

In the first of these six families are comprehended those fossils so well known to geologists as *Crinoideæ*.



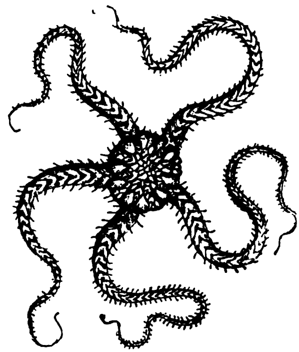
CRINOIDEÆ (STALKS SEVERED).

This curious creature looks like a petrified plant in flower, yet it in nothing but looks bears any resemblance to a flower. True it grows on a stalk, but the

stalk has no root, like sea-weeds; it only holds on to the rock by the foot of the stalk, as a ship holds on by her anchor.

But the likeness of these stalked star-fishes to flowers is so striking that they are called Crinoids, which means lily-like, from two Greek words which have this meaning.

Some star-fish resemble this class in first growing on a



SERPENT STAR-FISH.

stalk, and afterwards breaking loose and swimming away free into the wide water.

The multitudes of Crinoideæ which inhabited the primitive ocean exceed all conception. The immense deposits of what is called encrinital marble, which are found in some districts of England, are formed almost entirely by their remains.

The second family of the star-fishes is that of the

*Ophiuridæ* (from *ophis*, a serpent, and *oura*, a tail). These are very common along our sea-coasts.

Their bodies, small and round, are furnished with fine, long, and slender arms. These arms, instead of the sluggish movement of the ordinary star-fish, are endowed with great activity, and move and twist about with great rapidity, and, by their resemblance to the tails of small serpents, suggest the name by which they are distinguished. The celerity of motion possessed by these arms furnishes the creature with power to crawl with considerable rapidity.

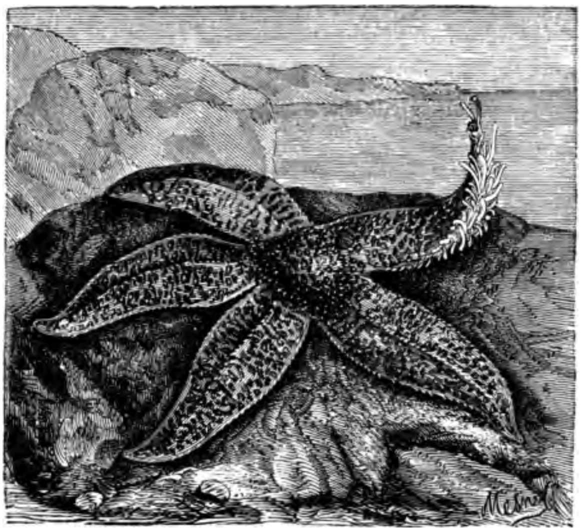
The third family are the *Asteriadæ* (from *aster*, Greek for a star), or true star-fishes. The fourth family is that of the *Echinidæ*, or sea-urchins. The fifth are the *Holothuridæ*.

There is a sixth, named the *Siphunculidæ*, in external appearance resembling worms, but their natural history has not been fully investigated.

The star-fishes, or *Asteriadæ*, have their bodies divided generally into five lobes or rays. In some cases the rays form the points of five angles, into which the body is divided. The upper surface of these rays is protected by a very thin skin, which seems to the touch as if filled with a soft pulpy substance.

The lower surface, however, is much more complex in structure. From the centre to the point of each ray runs a groove or channel, lined on each side by two walls of shelly matter, which form part of the skeleton of the little animals.

In each of these channels are a multitude of suckers. These suckers are placed on the ends of transparent footstalks; they serve the double purpose of *hand* and *foot*, enabling the star-fish to move from place to



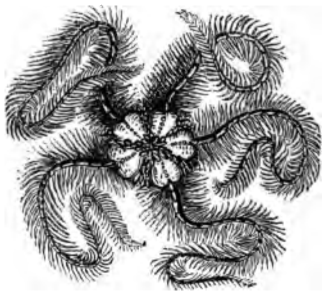
COMMON STAR-FISH.

place, seize upon its food, or to attach itself to one spot.

Individually the suckers exert little power, but their collective force is fully adequate to all the animal's requirements.

Another beautiful variety is the *Comatula*, or Feather star.

It possesses much elegance of form and beauty of colour. Its body is of small size, of fine rose colour, sometimes variegated with bands of crimson and yellow. Fine, long, and slender arms, feathered along their sides and furnished with claws, enable it to adhere to rocks or sea-weed with great force.



FEATHER STAR-FISH.

Its internal structure is most elaborate and wonderful, and cannot be well described without recourse to very minute detail; in fact, it must be seen, as no description can do justice to the marvellous mechanism of its organs.

Another beautiful species of these interesting animals is the Sun-star. It is so called because the disk is surrounded by twelve broad rays. In colour the sun-star is variable. Sometimes the whole body is red; some-

times, also, it is purple; sometimes the centre is red and the rays white.

Several of these remarkable creatures now described are further distinguished by the possession of a most singular power—the power of self-destruction; for on being removed from their natural element they fall to pieces: they are hence called "brittle stars." Whether this peculiarity is the result of voluntary action, or the natural effect of exposure to the air or to touch, it seems difficult to determine, although in some instances it looks like an act of will on the creature's part.

Let us hear what Professor Edward Forbes says on this point. Having taken a fine specimen of the brittle star-fish measuring some two feet across, he gives the following humorous account of its suicidal propensities:—

"Never having seen one before, and quite unconscious of its suicidal powers, I spread it out on a rowing bench, the better to admire its form and colours. On attempting to remove it for preservation, I found only an assemblage of rejected members. My conservative endeavours were all neutralised by its destructive exertions; and it is now badly represented in my cabinet by an armless disk and a diskless arm.

"Next time I went to dredge on the same spot, determined not to be cheated out of a specimen in such a way a second time, I brought with me a bucket of cold fresh water, to which article sea-fishes have a great antipathy. As I expected, a luidia came up in the dredge, a most gorgeous specimen. As it does not generally break up

before it is raised above the surface of the sea, cautiously and anxiously I sank my bucket to a level with the dredge's mouth, and proceeded in the most gentle manner to introduce luidia to the purer element.

"Whether the cold air was too much for him, or the sight of the bucket too terrific, I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In despair I grasped at the largest, and brought up the extremity of an arm, with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision."

Before quitting the subject of star-fishes, a highly interesting fact in the natural history of the *Cribella oculata*, common on almost every sea-shore, must be noticed—its maternal solicitude.

The young of the star-fish are produced from ova, and the *cribella* by bending its arms forms its body into a concave figure and hatches the eggs in the hollow thus made. During this process, which it is said requires eleven successive days, the mother star-fish remains in this recurved and contracted form necessary to her purpose, and in that attitude cannot obtain any nourishment.

This singular circumstance affords one of the many proofs which have been discovered that parental instincts are not confined to the higher orders of animated beings, but are shared with them by the humblest creatures.

Another observation we would make on the voluntary dismemberment of the luidia.

Various species of Crustaceans, such as crabs and lobsters, possess the power of dismemberment, and share it not only with the "brittle stars," but with many other creatures both terrestrial and aquatic. These and a great many analogous phenomena seem to afford very conclusive evidence that in a numerous class of animated creatures, bodily injury is not accompanied by what we call pain, as is the case in the higher order of animals.

If this be so, and there is little reason to doubt it, the fact presents us with a very beautiful and striking illustration of the beneficent wisdom of that Great Being "whose tender mercies are over all his works." Pain is to man an admonitory intimation of physical injury received or threatened; it is a provision absolutely essential to his security, since, without this warning, he might sustain irreparable damage without being aware of it.

There is therefore reason to believe that in proportion as the lower orders of animated creatures are exposed to injury they are free from those sufferings which injuries produce in those of higher organization, and in this respect there is reason to perceive an evidence of the same benignity which so great a variety of other considerations tend to favour.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## CHAPTER II.

### SEA-URCHIN AND SEA-CUCUMBER.

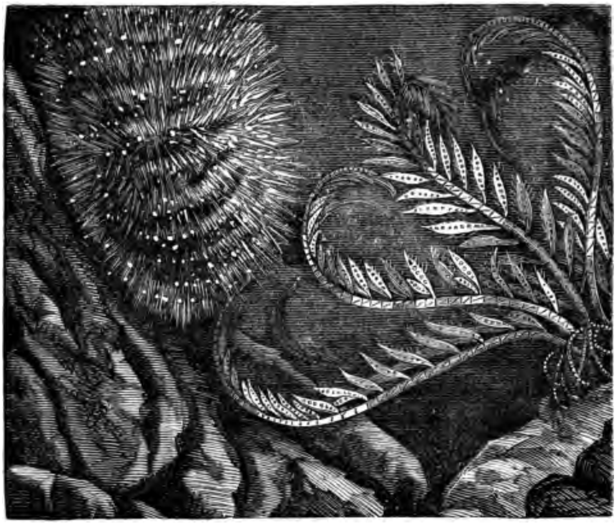
THE Sea-urchin belongs to a race whose pedigree extends far into the ages of antiquity.

Let us hear the naturalist, Gosse, on its contrivances:—

"The house in which this little creature dwells is globular, but somewhat compressed, much like the orange in shape. Its structure is most interesting.

"What a wonderful piece of mechanism is a sea-urchin! Accustomed as I am to the multitudinous contrivances and compensations that present themselves at every turn to the philosophic naturalist, often as surprising and unexpected as they are beautifully effective, I am yet struck with admiration at the structure of an *Echinus* whenever I examine it anew.

"A globular hollow box has to be made, of some three inches in diameter, the walls of which shall be scarcely thicker than a wafer, formed of unyielding limestone, yet fitted to hold the soft tender parts of an animal which quite fill the concavity at all ages. But in infancy the



SEA-URCHIN AND ROSY FEATHER-STAR.

animal (and, of course, its *box*, as this must be full) is not so big as a pea; and it has to grow till it attain its adult dimensions. The box is never to be cast off and replaced by a new one; the same box must hold the infant and the veteran urchin. The limestone not being

a living tissue, but an inert earth, can grow only by being deposited. Now the vascular tissues are within, and the particles they deposit must be on the interior walls. This would indeed augment the amount of limestone in the box, but it would be at the expense of the contained space. The thicker the walls, if thickened from within, the less room in the cavity; but what is wanted is *more* room, even more, and more. The growing animal feels its tissues swelling day by day, by the assimilation of food, and its cry is, 'Give me space! a larger house, or else I die.'

"How is this problem solved?

"Ah! there is no difficulty.

"The inexhaustible wisdom of Jehovah the Creator has invented a beautiful contrivance for the emergency. The box is not made in one piece, nor in ten, nor in a hundred; six hundred distinct pieces go to make up the hollow case, all so accurately fitted together that the perfect symmetry of the outline is not broken, and yet, thin as their substance is, they retain their relative position with unchanging exactness, and the slight brittle box possesses all requisite strength and firmness.

"Each of these symmetrical pieces of shell is enveloped by a layer of living flesh, a vascular tissue of exceeding thinness, which passes up between the joints where one meets another, on every side, and not only so, but actually spreads itself over the whole exterior surface. So that when you take up an urchin into your hand, and, having rubbed a small space clear of spines, look on

it, you have not, as you may suppose you have, exposed the surface of the shelly box, but only the flesh that covers it; yet this is so transparent and colourless, so inconceivably thin, so absolutely adherent at every point, that its presence will not be discernible to feeling or sight without the aid of high microscopic powers.

"This being so, the glands of the investing fleshy tissue secrete lime from the sea-water which holds it in solution, and constantly deposit it, after a determinate and orderly pattern, on every part of the surface of each

SEA-URCHIN WITH SPACE CLEAR OF SPINES.

shelly piece; the inner face, the outer face, and each of the sides and angles of the polyhedron grow together, and all so evenly, that while the dimensions increase, both of thickness and superficies, the form characteristic of that individual piece is maintained with immutable mathematical precision. Thus the volume and capacity of the box grow with the growth of the individual segments, and it ever keeps the globose shape at first imposed upon it.

"But this is but a small part of the mechanism of this interesting tribe.

"If you put into a basin of sea-water one of the pretty kind which we find so abundantly under stones at low water, whose green spines are tipped with rosy purple, like the tentacles of an *Anthea*, you will presently observe it marching majestically along by means of the hundreds of sucker-feet, which it possesses in common with the star-fish. Now, if you have the empty box of an urchin of this same kind, and, taking it in your hand, hold it up to the light, and look into the cavity from the under or mouth side, you will have a very interesting spectacle. The light streams in through a multitude of minute holes, as smooth and regular as if drilled with a fairy's wimble; and these holes are arranged in a pattern of elegant symmetry.

"Put the living and the dead together. These tiny orifices, as minute as the point of the finest cambric needle could make in a bit of paper, afford exit to the suckers, which are of course equally numerous. Through these pass the slender pellucid tubes, filled with elastic fluid, which carry at their tips a flat ring of calcareous shell, affording to each the form and firmness to make it an adhesive sucking disk, in the centre of which a tiny vacuum is created at will by muscular retraction."

Other parts of this creature's structure are no less striking and interesting than those now described.

If the shell be denuded of the spines, it will appear to be from top to bottom marked out by five double rows of small holes into ten spaces shaped somewhat like the gores into which paper is cut in forming a balloon. Each

of these spaces is studded with rows of minute hemispheres. These little points, which seem when the shell is divested of its spines to be merely ornamental, are a portion of a piece of mechanism truly admirable. It is to one of these that each of the spines is fixed when the animal is alive. Each spine is furnished with a socket into which the little point or prominence fits, so that the spine revolves upon it precisely in the manner of

SEA-URCHIN SHELL STRIPPED OF SPINES (Seen from above).

what is called by engineers a universal joint,—a kind of mechanism exemplified in the shoulder joint of the human frame, with this difference, that in the human arm the convex part of the apparatus revolves in the socket, whereas, in the case now referred to, the spine with the socket revolves upon the stationary convexity or point.

The spines thus adjusted are put in motion by a set of appropriate muscles, acted on by nerves obeying the

instincts of the animal. From each of the holes already mentioned issues a sucker, by which the urchin either attaches itself to one place or changes its position.

Among the spines are likewise numbers of minute pincers, called by naturalists *pedicellariæ*, consisting of a stalk with a nob at the end furnished with three hard teeth, some obtuse and others elongated. The use of these pincers does not appear to have been ascertained; but whatever be the special use for which they are intended, they are beyond doubt, like all the understood portions of the complex structure, adapted with inimitable skill to the purpose intended.

If, again, we examine the mouth of the urchin, we shall find its mechanism to be extremely complex. It is scarcely possible, indeed, to convey a suitable notion of it without pointing out its parts in a living specimen; but sufficient may be said to incite the reader to examine for himself.

The teeth or jaws consist of five pieces of triangular shape, fitting together into the form of a cone, in the centre of which is an additional tooth. This cone occupies the middle of the orifice in the base of the shell, and the teeth or jaws of which it consists are attached to the arches around the orifice by means of powerful muscles, and are furnished with others enabling them to work upon each other so as to triturate and grind the substances on which the animal preys. To this purpose the jaws are so perfectly adapted that very hard substances exposed to their action are speedily reduced to a pulp.

The elaborate and complex mechanism which is presented to us in the structure of the sea-urchin, cannot be perceived by the intelligent and candid observer without those convictions which consummate excellence in the adaptation of animal mechanism rarely fails to originate.

SEA-CUCUMBER.

"In a moderate sized urchin," observes Professor Forbes, "I reckoned sixty-two rows of pores in each of the ten avenues. Now as there are three pairs of pores in each row, their number multiplied by six and again by ten, would give the great number of three thousand seven

hundred and twenty pores; but as each sucker occupies a pair of pores, the number of suckers would be half that amount, or eighteen hundred and sixty. The structure of the egg-urchin is not less complicated in other parts. There are above three hundred plates of one kind, and nearly as many of another, all dovetailing together with the greatest nicety and regularity, bearing on their surfaces above four thousand spines, each spine perfect in itself and of a complicated structure, and having a free movement on its socket. Truly the skill of the great Architect of nature is not less displayed in the construction of a sea-urchin than in the building of a world!"

Of the fifth family, the *Holothuridæ*, Sea-cucumber, is a curious and interesting specimen. Their name is given on account of their long cucumber-like shape.

This creature possesses the power of self-mutilation. When it fears death it ejects all its teeth, its stomach, its digestive apparatus, and reduces itself to a simple membraneous sac. It would seem as though it performed this wonderful feat because it conceived the chances of life were greater the less there was of it to live. Dr. Johnson, who kept one of these animals in an aquarium, having neglected to feed it, when after some days he visited it, found all its internal apparatus thrown out on the floor of the vessel, and the holothuria itself was a shrunken, dilapidated, and empty tube. Yet it was alive, and in three months teeth, stomach, and digestive apparatus were produced anew.

Another singular property is their power to divide

themselves into two parts, each part becoming a separate creature. When division is taking place the extremities enlarge, and the middle of the animal begins to contract, until it is but a thread. At length it snaps, and two distinct creatures are formed which in time furnish themselves with all necessary organs.

A peculiar genus of the holothurias, the *synapta*, is a native of the English Channel. It seems as if it were a tube of rose-coloured crystal, and passing through this tube appear five narrow ribbons of white silk, which mingling together form the head. Its organs are finer than the thinnest gauze; and yet this creature lives on a sandy bottom, and it passes sand through it—the sharp angles of the grains being visible to the naked eye—yet the finest membrane is not injured through which they pass.

This creature has a peculiar mode of meeting famine. It cuts off all parts of its body with which it can dispense. This self-destruction has been known to continue until only the head was left, which, as soon as food was supplied, that head began to reconstruct the body it had in its poverty thrown away.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## PART III.

## MARINE WORMS.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## Part III.

### CHAPTER I.

#### MARINE WORMS AND BARNACLES.

THERE are tribes of marine worms which inhabit tubes, and from this circumstance are called Tubicolæ. These animals belong to the class known as *Articulata*, or Jointed Animals.

The tubes they inhabit are constructed by themselves, either from particles of sand joined together by some species of cement with which they are provided, or consisting of lime secreted for the purpose by some process similar to that by which the shells of various crustaceans are formed.

There are several varieties, called Serpula, which are

found upon shells, stones, or broken glass and pottery, which have been long immersed in the water. On these, the tube-worms form their abodes, consisting of a vermiform encrustation of carbonate of lime.

There are, however, several species of serpulæ. Some are very minute, some form their shelly tubes in a spiral manner, others twist them into a great variety of convolutions. In others, again, the tubes are lime-coloured; in others perfectly transparent; in some they are round, some wrinkled and angular. Some of the serpulæ are evidently gregarious, a large number of them occupying the surface of the same shell or stone, while, on the other hand, we find a large species which is solitary, occupying the surface of one shell, and living without any companion.

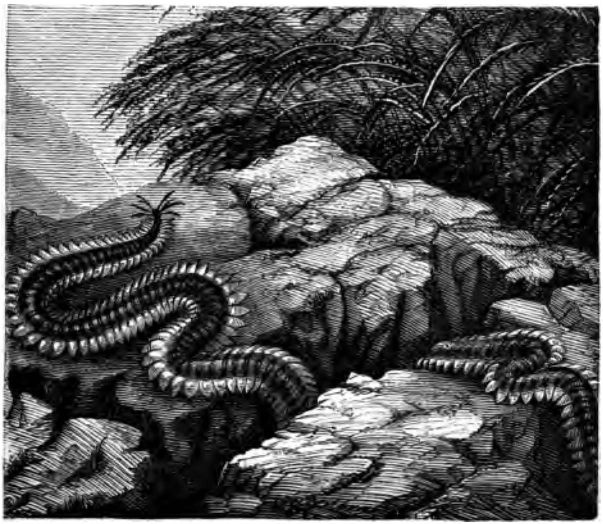
The serpulæ possess peculiar breathing apparatus, which consists of a fan-shaped body extremely graceful in its form and brilliant in its colouring, which the worm, in order to breathe, protrudes from the end of its tube-shaped domicile.

By obtaining specimens of the serpulæ alive and placing them in sea-water, the process of respiration may be easily perceived. At the mouth end of the tube is a door, the mechanism of which is singularly admirable. This door, when the whole of the animal is immersed in water, is opened, and the inhabitant slowly protrudes the upper part of its body, from which soon afterwards it spreads out its two fan-shaped branchiæ or respiratory organs, the purple or scarlet hues, the form, and the motions of which are extremely interesting.

There are marine worms, called Nereis, of several varieties.

Some of these worms are very minute, but they possess the faculty of emitting light, and are able to illuminate the midnight waters with marvellous splendour.

Another species is of much greater length, but not



HAIR-WORM.

possessed of the power of producing light. It is about four inches in length, and of a bluish-green colour, semi-pellucid, and formed of about a hundred and eighty-four distinct segments. It is frequently found in the sand at low water.

Another species is a foot in length, and as thick as a goose quill; the tail is orange colour, and the rest of the body exhibits a beautiful iridescence.

Instead of being sedentary and attached to one place, they move along the bottom of the water from place to place with great rapidity. The movements of these worms

SCARLET SERPULÆ.

are extremely active and graceful. They are all greedily sought after by all kinds of fishes, to whom their naked bodies furnish an easy repast; but their movements are so rapid that they readily make their escape by hiding beneath the fronds of sea-weed or between the stones.

Before quitting the numerous family of marine worms, one may be mentioned which is not uncommon on the coast of Devonshire, and also in some localities on the west coast of England. It is the largest example of the Gordius or hair-worm. It grows to the extraordinary length of thirty feet, and possesses the singular power of contracting and expanding itself at will, one of eight feet in length being found to contract itself to one-eighth of its extent. The colour of this remarkable annelid is dusky brown with a tinge of green. Those of the largest size are taken by dredging in deep water, and are found inhabiting old bivalve shells.

Belonging to the tribe we are now referring to is the sea-mouse, or Aphrodite, a creature of which several varieties may be discovered on the shore after the tide has ebbed, and especially after a storm. The largest and most common is the *Aphrodita aculeata.*

Although of the family of worms, this creature altogether differs from its relatives in shape. Its body is oval, three or four inches in length, and from an inch and a half to two inches broad. Its back is clothed with silky hairs of a rich metallic lustre. Along its sides are bundles of bristles attached to muscular points which the creature can move at will, and which serve as organs of motion, either in swimming or crawling along the bottom. The splendour of the colours which adorn this creature, although its habitation is the mud at the bottom of the sea, is not inferior to that of the feathers of the humming bird.

There is a curious member of the curl-footed tribe known as the Barnacle. One of these barnacles is very common in some parts of the southern coasts of England and Ireland, where it is found in great numbers attached to drift wood. The bottoms of ships are sometimes covered with them.

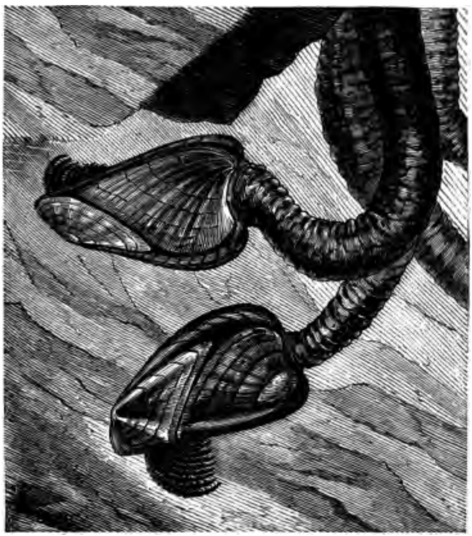
The shell of this cirripod is whitish, flattened at the sides, and opening down the edges by a slit. It is composed of five distinct pieces, united together by a membrane, and the whole is attached to a flexible stalk several inches in length, of a fleshy or tendinous character. It has a feathered apparatus by which it breathes, supposed to be the rudimentary feathers of a future bird to be excluded from the shell when arrived at a sufficient state of maturity.

This popular error is of considerable antiquity, and still prevails in many of those parts of the sea-coast in which the barnacle is found. Gerard, a naturalist who flourished at the close of the sixteenth century, and whose authority in his own day stood very high, not only repeats this fable as an ascertained truth in natural history, but enters into a detailed account of the metamorphosis by which it is changed into a bird.

The following is a passage from his "Herbal" on the subject, part of which has been frequently quoted by modern writers on natural history :—

"What our eyes have seene and hands have touched we shall declare. There is a small island in Lancashire called the Pile of Foulders, wherein are found the broken pieces of old and bruised ships, some whereof have been

cast thither by shipwracke, and also the trunks and bodies with the branches of old and rotten trees, cast up there likewise; whereon is found a certaine spuma or froth that in tyme breedeth into certaine shels, in shape like those of the muskle, but sharper pointed, and of a whitish



BARNACLES.

colour, wherein is contained a thing in form like a lace of silke finely woven as it were together, of a whitish colour, one end whereof is fastened into the inside of the shel, even as the fish of oisters and muskles are; the other end is made fast into the belly of a rude masse or

lumpe, which in tyme commeth to the shape and forme of a birde: when it is perfectly formed the shel gapeth open, and the first thing that appeareth is the aforesaide lace or string; next come the legs of the birde hanging out, and as it groweth greater it openeth the shel by degrees, till at length it is all come forth, and hangeth onlie by the bill: at short space after it commeth to full maturitie, and falleth into the sea, where it gathereth feathers and groweth to a fowle bigger than a mallarde and lesser than a goose, having blacke leggs and bill or beake, and feathers black and white, spotted in such a manner as is our magpie, called in some places a Pie-Annet, which the people of Lancashire call by no other name than a tree-goose: which place aforesaide and all those parts adjoining do so much abound therewith that one of the best is bought for three pence. For the truth hereof, if any doubt, may it be to them to repaire to me, and I shall satisfie them by the testimonie of goode witnesses."

This fabulous history of the origin of the bird so well known as the barnacle was by our ancestors held to be perfectly correct, and it still maintains its footing among many of our sea-shore population.

But natural history exhibits phenomena greatly more marvellous than any that originate in the imagination of a credulous naturalist. The metamorphosis which the barnacle itself does actually undergo prior to assuming its condition in the shell as above described, is fully as wonderful as that which it has been fancied to undergo subsequently.

The young of the barnacle have been discovered by naturalists to be minute creatures of an oval form, furnished with six pairs of legs! The six pairs of legs are each terminated by hairs, capable of impelling them with great rapidity through the water, all which act in concert with each other, like oars all pulled by skilful rowers.

After passing some time wandering hither and thither, these singular creatures voluntarily give up their youthful liberty, select the place of their future permanent abode, and attach themselves to it. Immediately after this, they begin to assume the form of a barnacle; their organs of locomotion, and even of sight, now cease to exist, and henceforth they depend for their food on what happens to come in their way.

Such alterations of condition and form are precisely the opposite of that which occurs in the instance of the jelly-fish already spoken of. These in their earlier stages of growth are attached to a stalk, and are successively thrown off like living buds, to wander through the watery plains.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## PART IV.

## SHELL-FISH.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## PART IV.—SHELL-FISH.

### CHAPTER I.

#### CRABS.

THOSE inhabitants of the sea which possess breathing apparatus, with jointed limbs and distinct sexes, are entitled Crustacea.

Crustacea are to be found in every part of the ocean, but in the tropical seas they obtain their greatest size, and are frequently possessed of most brilliant colours. The excellent naturalist who accompanied the expedition of the *Samarang* to Borneo, speaks with the liveliest rapture of the beauty of colouring which some large crabs exhibited, which he perceived on rocks in the deep water, but of which, from their singular activity, he found it impossible to procure any specimens.

The variety of form which the class exhibits is very remarkable.

One of the most singular species is the Spider-crab, of which there are several kinds. The body of this crab is triangular or heart-shaped, and the legs of great length, so that it is able to elevate its body very much in the same manner as some of the long-legged spiders, to which it bears no inconsiderable resemblance.

Another remarkable species is the Spinous-crab, not uncommon on many parts of the shores of Britain, one of

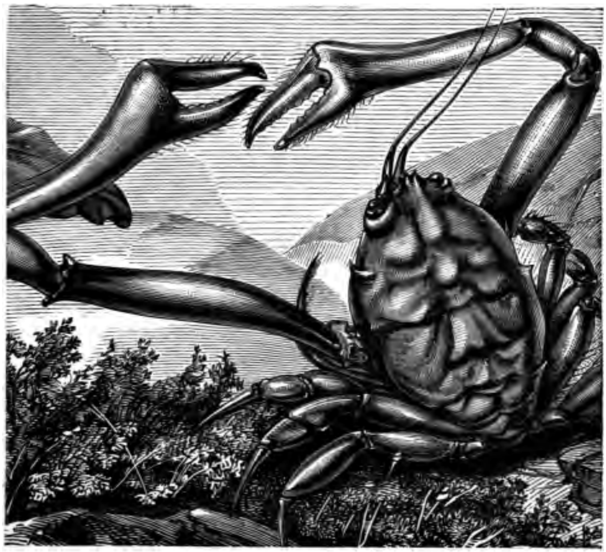
SPIDER-CRAB.

the family of the *Maiadæ*, which bears a considerable resemblance to the spider-crabs already spoken of. Its body is oval and convex; it possesses in front two stout horns, and the whole surface is covered with spines and tubercles of various sizes.

The Masked-crab is another singular species, deriving its name from the circumstance that the depressions and protuberances on its shell are so arranged as to present some resemblance to the human face.

The Wrinkled-crab is another species, the shell of which is corrugated transversely; and the Velvet-crab has a coat of fine hairs covering its shell.

The smallest of all the crab family is the Pea-crab, *Pinnotheres pisum*, of which there are several varieties.



MASKED CRAB.

They form a very interesting group, not only on account of their diminutive size, but their habits. These little crustaceans are only about a quarter of an inch across their shells, which are rounded and convex, and of a delicate texture of a brownish colour.

The most singular circumstance regarding these minute crabs is that they take up their abode in the large bivalve shells, not after the shell has been deserted, but during the life of its occupant. The pinna and other mussels, and the cockle, are the favourite dwelling-places of the pea-crab.

The Hermit-crab (*Pagurus Bernhardus*) is an interesting little creature, both in its structure and habits. It seems to constitute a sort of intermediate link between the

BODY OF HERMIT-CRAB.

crab and the lobster, and is, in consequence of its similarity to the lobster, as regards the length of its body, comprehended in the order to which the lobster belongs.

The very singular peculiarity of the hermit-crab is that, although its tail is prolonged like that of the lobster, it is wholly destitute of the hard, defensive covering in which the tail of the lobster is encased, and by which the anterior portion of its own body and its claws are enclosed.

HERMIT-CRABS.

U

Surrounded as he is with many and various enemies, and especially by those of his own relations of the crab and lobster families, the naked and exposed condition of so essential a part of the hermit's person would be speedily fatal to him, as the sharp pincers of his rapacious foes would quickly deprive him of his tail, a part of his body greatly more important to him than the caudal appendage of a terrestrial animal.

An instinct, however, is given to this otherwise helpless animal, which compensates for the apparent defect in its structure. Exposed to the imminent peril of having the posterior part of his body tampered with by the unscrupulous claws of his congeners, he ensures its safety by appropriating some shell suited to his own dimensions, into the spiral chambers of which he extends his unprotected part, and is at once in security, carrying about his abode with him with as much convenience as if it originally formed a part of his organization.

Deserted shells of very small size are suited to the hermit in his juvenile condition; but as he increases in bulk, being unable, like the original owner of the house, to increase its dimensions with his own development, he is obliged to seek a new domicile with ampler accommodation; and at length, on arriving at maturity, he finds it requisite to appropriate the shell of the whelk.

It is, however, extremely probable that the hermit does not always content himself with shells which have been abandoned by their true owners, but that he resorts to the most violent proceedings in order to eject the owner

and gain possession of his abode. This is rendered almost certain by the perfect freshness of many of the shells in which he is found.

To effect this nefarious purpose, the hermit probably seizes some unsuspecting mollusc, as it is grazing on the fronds of the sea-weed, and, lacerating it with his powerful claws, drags it from its abode, and, after devouring it, takes quiet and undisputed possession of the vacant shell. The stealthy manner in which the creature moves about, would enable it easily to surprise its victim, who, if possessed of any instinctive fear of such a foe, might be easily deceived by the hermit's outward similarity to one of its own harmless race.

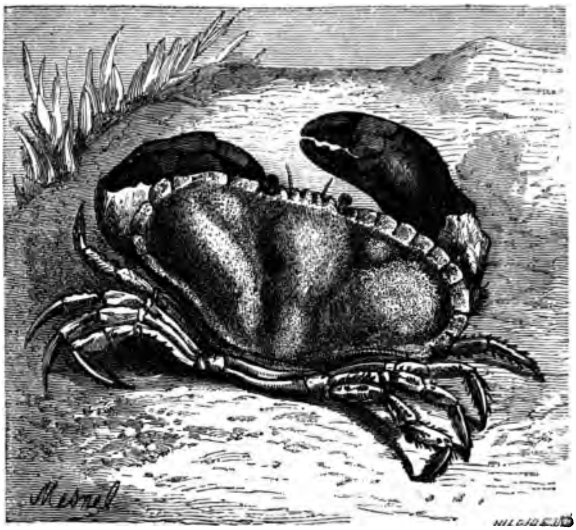
One of the most marvellous things in the history of the crab is the strange metamorphosis it undergoes before assuming its permanent form.

It was long believed by naturalists that the young of the crab, on being excluded from the ova, presented a minute but perfect resemblance to the species they belong to; and this belief gained support from the circumstance that vast numbers of very minute crabs are frequently to be found on the sea-shores. This opinion, however; has been found erroneous; but the change of form which the creature undergoes is so remarkable that, were it not established upon unquestionable evidence, it could not be credited.

Certain minute creatures to which the name Zoea was formerly applied, and which were supposed to form a distinct tribe of crustaceous animals, have been dis-

covered to be the young of crabs. But nothing can be more dissimilar from the form and habits of the crab than that of the diminutive zoea.

When the crab is first hatched and escapes from the egg, its appearance is in the highest degree grotesque.



COMMON CRAB.

Its head is shaped like a Russian helmet, with a long spike projecting from the top of it. In the front of this singularly-formed head are the antennæ and a long beak, together with a pair of huge eyes, not raised on supports as in the full-grown crab, and beneath are four pairs of

legs, with hairs at their extremities, and a long, jointed tail.

Thus furnished, the little creature is capable of swimming with rapidity through the water, and in this respect differs entirely from its parents, who, instead of sporting through the waves, live only at the bottom of the sea.

After remaining in this shape a certain length of time, the zoea undergoes its first change; and approaches in some degree its permanent form; the eyes become elevated on stalks; the claws appear; but the tail is not yet laid aside, and the creature still continues to swim through the water.

The next stage completes the progressive metamorphosis, and the form of the crab is in all respects assumed; the power of swimming is laid aside, and the little crustacean, although scarcely yet the eighth of an inch in size, relinquishes its mode of life, and its habit of living near the surface, for a very different state amidst the rocks and sea-weed at the bottom.

Strange as these successive alterations of form and habits are, they are not more so than those of other creatures with which we are more familiar, as, for example, the mutation of the caterpillar into a butterfly. But the result appears very different.

The caterpillar advances from its condition to one not only displaying more complexity of structure, but habits of vastly increased activity, with power to range through the bright sunshine, amidst the perfume of many-coloured

flowers, and amidst those sounds of joy of which its senses beyond doubt have a perception.

But how different is the result as regards the zoea!

Although its organs and faculties are much more perfect when it assumes its permanent condition, the scene of its future existence presents no analogy with that to which the caterpillar is advanced. The waves, bright with sunshine, are no longer the scene of its activity; it sinks to the bottom, and the perfect condition of its habits and organs consigns it to a state of comparative darkness and inactivity.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## CHAPTER II.

### SHRIMP AND LOBSTER.

WE are now to look at another order of crustaceans in which the prolongation of the animal's body into a tail distinguishes it from all the various species of crabs.

The shrimp (*Crangon vulgaris*) is a well-known inhabitant of our sea-shores, frequenting some sandy beaches in vast multitudes.

The prawn (*Palæmon serratus*), which is a shrimp of large size differing in some minute particulars from the common shrimp, is likewise found on many of our shores among loose stones; and, what is remarkable, it is sometimes taken at sea on the surface of the water when there has been a depth of more than thirty fathoms.

The young of the shrimp or prawn are often found in myriads on the beach close to the margin of the sea. These, during the ebb, each receding wave leaves for a while uncovered, when they may be seen leaping as they endeavour to find their way to their native element, which threatens to leave them high and dry upon the sand.

Dr. Paley, speaking of the happiness which such creatures probably experience, thus describes the movements of the young shrimp, and deduces from them a lesson of Divine goodness:—

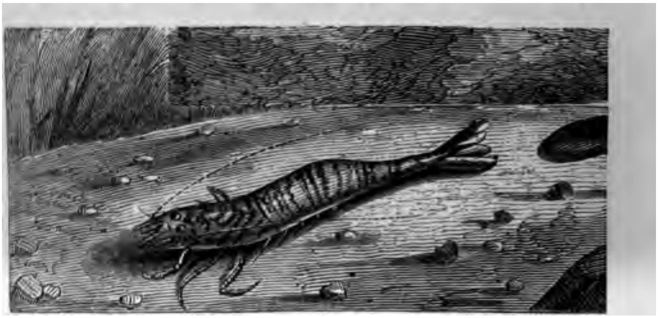
"Walking by the seaside on a calm evening upon a sandy shore and with an ebbing tide, I have frequently remarked the appearance of a dark cloud, or rather very thick mist hanging over the edge of the water, to the height, perhaps, of half a yard, and the breadth of two or three yards, stretching along the coast, as far as the eye could reach, and always retiring with the water.

"When this cloud came to be examined, it proved to be nothing else than so much space filled with young shrimps in the act of bounding into the air from the shallow margin of the water, or from the wet sand. If any motion of a minute animal could express delight, it was this; if they had meant to make signs of their happiness, they could not have done it more intelligibly. Suppose then, what I have no doubt of, each individual of this number to be in a state of positive enjoyment, what a sum, collectively, of gratification and pleasure have we before our view!"

In the common lobster the body and thorax are smooth, the antennæ long, the claws and fangs large; one of them,

which is greater than the other, has the inside of the pincers tuberculated; the other which is less in size, is not tuberculated, but serrated on the inner edge.

The habitation of this species is the clearest water at the base of rocks overhanging the sea. Places of this description are frequent in many parts of the coast. The western and northern shores of Scotland abound in places where lobsters are found in great numbers, many of which



SHRIMP.

are of great size. Various parts of the English coast, and many localities on the shores of the sister island, are frequented by this crustacean.

Lobsters are extremely prolific; more than twelve thousand eggs have been counted under the tail of one hen lobster. They begin to breed in spring, and continue doing so the greater part of summer, depositing their ova in the sand where they are hatched.

In addition to the power of creeping along the bottom,

and rising gracefully over the sunken rocks and the sea-weed, the lobster possesses the power of darting or shooting with great rapidity through the water. This act is performed by means of the tail, the broad plates at the end of which, put in motion by the powerful muscle connecting them with the anterior part of the body, strike the water with immense force, enabling the lobster to project itself many feet.

PRAWN.

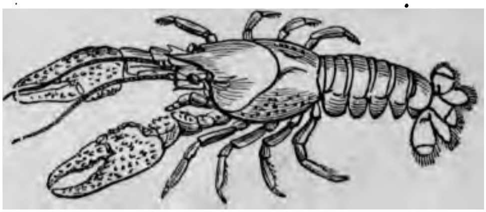
One of the most singular feats performed by the creature is that of throwing itself, apparently with one stroke of its tail, directly into its hole, from a distance, it is said, of twenty or thirty feet.

In all the crustacea, crabs as well as lobsters, the shelly armour which they wear being inelastic and incapable of accommodating itself to the increased size of the animal, an admirable provision is made by which, from time to time, the covering can be thrown off, and its place supplied by

a new suit perfectly adapted to the convenience of the possessor. But for this provision, the animal upon increasing in size must inevitably perish.

Crabs and lobsters are said to cast their shells once a year, and the facility with which this apparently impossible process is performed is truly marvellous.

At first sight it would appear as impossible for the animal to extricate itself from its unyielding envelope as it would have been for a soldier, in the days when complete



LOBSTER.

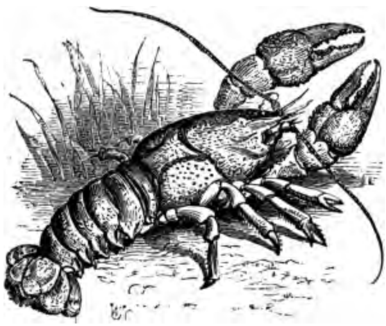
suits of armour were worn, to find his way out of his steel clothing without opening the joints and separating the pieces composing it. Impossible as the process appears, however, the crab and lobster are gifted with the power of performing it with perfect facility.

We are indebted to the celebrated naturalist, Reaumur, for an account of the manner in which the cray-fish or fresh-water lobster throws off its shell prior to obtaining a new suit of armour. The animal retires to its hole so as to be free from danger and interruption, and remains for several days without food. During the period it is probable it becomes more or less attenuated

while a new skin is in the act of forming under the shell.

Observing that a cray-fish was about to moult, Reaumur carefully observed the method in which the action was performed.

The animal commenced by rubbing his feet together and struggling violently, as if by its contortions to loosen the shell. It then appeared to distend its body, upon which the first segment of the shell of the abdomen sepa-



CRAY-FISH.

rated from that of the thorax, the membrane which united these portions of the crust then burst asunder, and the new body appeared beneath. After resting awhile, the cray-fish repeated the process till all the pieces of the armour were separated and cast off, and so completely that in the exuviæ no external part was found wanting.

How the large muscles of the claws were to be freed from their covering seemed the most insoluble part of the

problem; but this was also effected without difficulty, the sutures dividing the articulations having opened, allowing the soft muscles to be withdrawn. Every part of the shell is at last thrown off, the muscles being withdrawn even from the antennæ, and the case appears perfect and complete.

This process, so observed in the cray-fish, is probably similar in all the other crustacea.

LOBSTER FISHERY.

The change when completed is followed, like all violent muscular action, by reaction. The animal is wearied as well as defenceless, and remains secluded in its hole till its strength returns and its shell is hardened. During this period it is quite incapable of capturing its prey. The whole shell is soft, and even the pincers are as pliant

as parchment, so as to be unable to hold any object requiring the exertion of strength.

The larger crabs when in this helpless condition may be easily taken by the naked hand in their holes among rocks at low-water mark; and it is somewhat amusing to insert one's finger within the formidable-looking forceps and observe the futile effort the poor animal makes to seize upon the aggressor.

One of the most singular faculties possessed by the crustaceans is the power of voluntary dismemberment.

This faculty, however, is exercised by other animals. There are some species of lizards which, on being alarmed, or even on being touched, strike off a considerable portion of their tails, and shuffle off apparently no worse for the loss of the important appendage. Some species of star-fishes have this faculty also, being capable of separating themselves into a great many pieces.

The lobster is said to shake off its claws at the sound of thunder or on the report of a cannon; and it is extremely probable that the act of so doing gives little or no pain.

Their limbs are often lost or injured; but they possess the extraordinary ability to restore the loss or heal the injury.

Both crabs and lobsters are able to throw off the whole remaining part of an injured limb, and, according to the ablest comparative anatomists, they do so for two purposes, to stop the excessive flow of blood from the injured part, and to lay bare the organ which reproduces

the limb. The bleeding ceases whenever the damaged part is cast off, and a new limb shortly makes its appearance; and although at first it is much smaller than the other limbs, it attains its full dimensions on the first occasion of moulting.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## CHAPTER III.

### COCKLE AND SCALLOP.

OF the headless mollusca (*Acephala*) class there is a large number of familiar "shell-fish," as they are popularly called, which are full of interest.

Let us suppose it to be low water on one of those sandy shores where the common cockle may be found. It is a spring-tide, and the waves have retreated far below their usual limit, leaving a wide extent of sand quite bare. Furnished with a trowel, we dig a little way below the surface, and our labour is at once rewarded with a handful of cockles. One of these will serve to illustrate the internal structure of several other species of bivalve molluscs.

The shelly covering of the animal consists, we perceive, of two pieces. In the cockle, the clam, and some others, each of these two pieces is almost hemispherical; in the oyster, the scallop, and others, they are, on the contrary, almost flat.

The hinge which unites them is a beautiful piece of mechanism.

The processes of the opposite parts of the hinge lock into each other, and are firmly kept together by a ligament of great strength, and yet so elastic as to act as a spring in opening the shell (whenever the animal relaxes the muscle which keeps it close), precisely as the spring of a watch-case throws it open, whenever the power keeping it shut is removed.

On opening the cockle, we perceive that the whole of the inner surface of the two valves, or shells, is lined with a smooth and delicate membrane, or skin. This membrane, because it encloses the body of the animal, is termed the mantle.

It is found in all the molluscs, although subject to various modifications. It is, in fact, an essential part of their structure, and among the marvels of creative design there are few things more wonderful than the office which this apparently simple membrane performs.

The mantle is an apparatus adapted to form the shell by which the mollusc is covered, and to deposit the colouring matter by which it is adorned. Simple as the structure appears to be, the manner in which it is fitted

to effect this object far exceeds the highest efforts of human ingenuity.

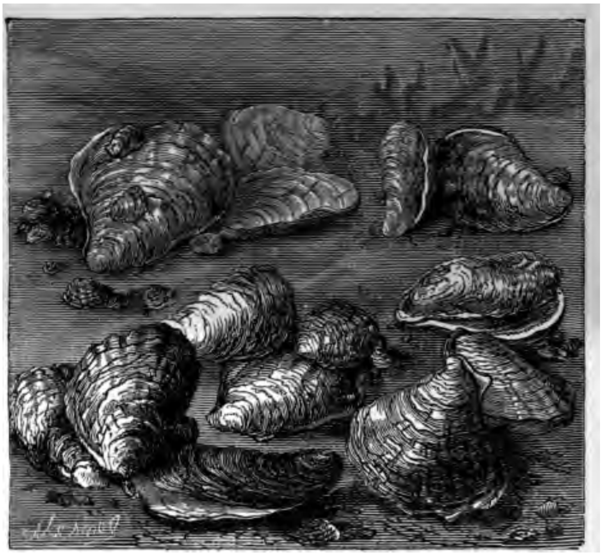
It is composed of minute cells, differing in size, shape, and arrangement, in different species of molluscs, and containing calcareous matter secreted from the fluids of

COCKLE AND BANDED VENUS.

the animal. The edges of the membrane are occupied in adding continually to the edge of the shell, as its occupant increases in size, and the inner portions of it are, at the same time, employed in adding to the thickness of the shell, depositing the beautifully-smooth

and pearly substance so remarkable in their inner surfaces.

Thus, the fine mother-of-pearl on the inside of the oyster-shell, and the various patterns in yellow, blue, pink, brown, crimson, and other colours which ornament



OYSTER-BED.

the exterior of other shells, is all the work of this simple and efficient piece of mechanism.

The body of the cockle, besides containing the viscera, is furnished with a yellow-tipped instrument, which is by

naturalists called its foot, being the means by which it moves, burying itself with ease in the sand.

The Scallop, the empty shells of which are frequently found scattered along the margin of the sea, is not found, like the cockle, buried in the sand, but is taken, like the oyster, in deep water, by means of a dredge. There are more than a dozen varieties peculiar to the British shores.

This mollusc is well known to every visitor to the sea-shore, and its beautifully-marked and regularly-fluted

FRINGE AND EYES OF SCALLOP.

shell is generally a great attraction to those who amuse themselves by gathering specimens of our native shells. What has already been said of the mantle is equally applicable to that of the scallop. Around its margin, however, there are numerous pellucid, fringe-like tentacula, which the animal can protrude or retract at will.

But what is most remarkable is, that along its margin is a row of singularly beautiful eyes, so placed that each

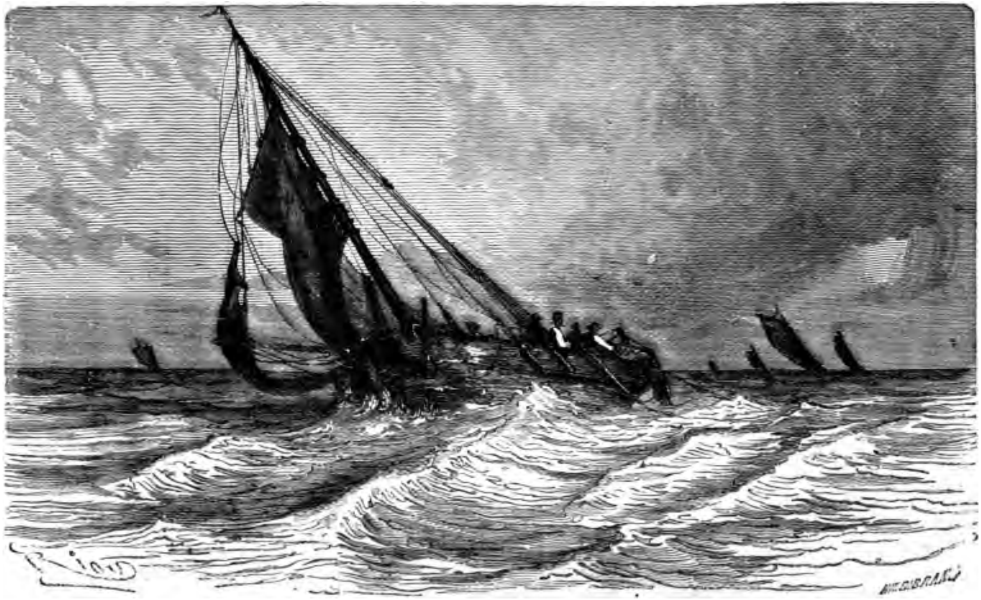
eye can look out upon the watery world through one of the grooves in the fluted shell.

Even the unassisted eye is arrested by their flashing brilliance, but with a powerful lens they look like rubies set in sockets of sapphire, from which the light blazes forth

SCALLOP BED.

with incomparable brilliance. These are the pecten's eyes, each of which possesses all the parts requisite for perfect vision.

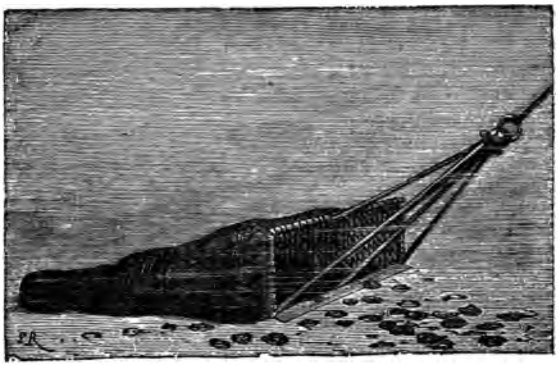
The valves vary much in colour. Some are pure white; some white with a crimson line along the sum-



TRAWLING FOR SCALLOP.

mit of each radiating ridge; some rosy, crimson, or lilac; some cream, straw-yellow, deep yellow; some dull brick-red, dark purplish-red, or sienna-brown; some are marbled with black on a red ground, making a very rich pattern.

The largest specimens, and those with great variety in hue, are found in deep water, and for the most part congregated in large numbers on some particular spot of



TRAWL, ON SCALLOP BED.

the sea-bottom, which is called a scallop-bed. Such are found in Weymouth Bay, and in Torbay; and there the shell-fish can be obtained in sufficient quantity for the market. At Weymouth there is a considerable business done in these delicacies, which is, however, almost all in the hands of one dealer, from whom I have collected some details of interest.

The ordinary trawlers avoid the scallop-beds, if possible, because they are liable to have their nets torn by them—the sharp valves doubtless catching and cutting the meshes. But they often bring up many unintentionally, and a naturalist would find a trawler's refuse a most productive field: for numbers of rare and valuable zoophytes and other forms of life come up attached to the shells, which might easily be saved, but are not; the men "have no time, for they are so anxious to get their craft into a berth, and then to take out the fish as soon as the trawl is up."

Twenty bushels of scallops are sometimes taken at once; but this is rare. The average produce of the Weymouth trawlers is five bushels per week, which are readily sold at twopence per hundred—about seven hundred going to the bushel.

As a proof of the tenacity of life possessed by this species, a fisherman assured me that he once put a quantity in a bag into a cupboard, and forgot them, till, after the lapse of a week, turning them out he found them alive.

Unlike many bivalves, the scallop possesses the power of locomotion, a circumstance stated by Aristotle, and, although subsequently doubted, now confirmed by modern naturalists. The animal, by opening its shells, and suddenly shutting them, is enabled to propel itself through the water, and from the rapid movements of its variegated valves, it has been appropriately called the sea-butterfly.

The beautiful figure of the Crouching Venus in the celebrated Maffei Collection is placed sitting in a shell of this kind, in correspondence with the classic myth that the sea-born goddess arose from the ocean in a scallop.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## CHAPTER IV.

### WHELK AND LIMPET.

BESIDES shell-fish without heads, as the oyster and cockle, there are shell-fish which have heads. The scientific name of this class is *Encephala*, which simply means having heads.

Of molluscs having heads, the whelk, the winkle, and the limpet are the most widely known.

It is to the empty shell of the common whelk that the poet Wordsworth refers, in his description of the effect produced on the imagination of a child by the murmuring sound heard from the shell when held close to the ear.

> "I have seen
> A curious child applying to his ear

The convolutions of a smooth-lipped shell,
To which in silence hushed, his very soul
Listened intensely, and his countenance soon
Brightened with joy; for murmuring from within
Were heard sonorous cadences whereby,
To his belief, the monitor expressed
Mysterious union with its native sea."

The whelk is carnivorous, and one of the most interesting peculiarities in its structure is a powerful piece of mechanism by which it is enabled to bore into the shells of those molluscs on which it preys.

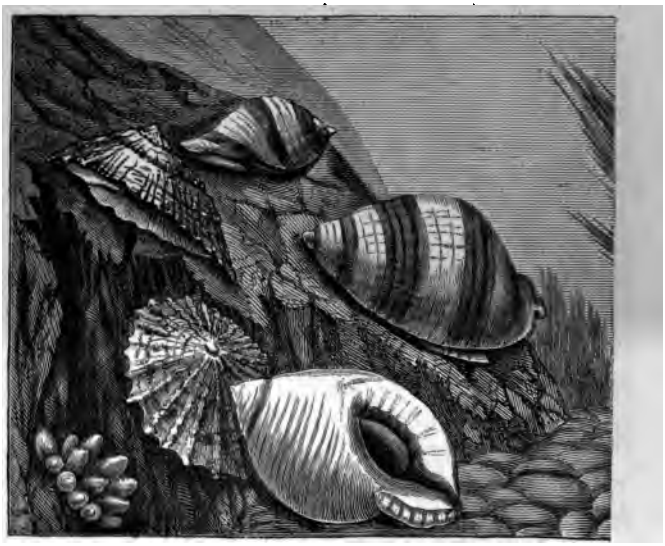
The egg-clusters of the species of whelk now referred to are very remarkable, and may often be picked up on the shore after a storm, mingled with the froth of the sea, and the sea-weed recently torn from the rocks.

These clusters consist of a light sponge-like body, consisting of several globular subdivisions attached together, and about six or eight inches in length.

Another, but a much smaller species of whelk, is a well-known inhabitant of the shallow pools left by the receding tide, and may be found attached to the rocks beneath the sea-weed. It is the dog-winkle (*Purpura lapillus*); it is about an inch in length; the shell is very hard and thick, and either white or ornamented with bands of yellow and brown.

This mollusc, like the murex,—a species of whelk, which yielded the Tyrian purple so celebrated in ancient times,—is also remarkable for furnishing a permanent dye, which, when applied to white linen, and exposed to the

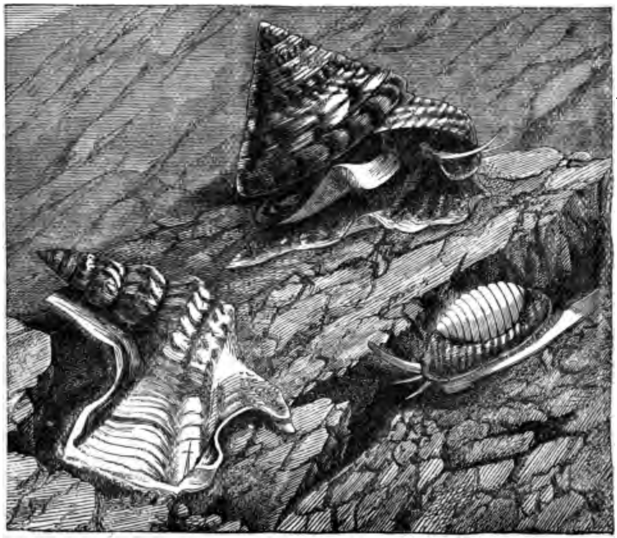
sun, the pale tint becomes a brilliant yellow; soon afterwards it deepens into a delicate green, which grows darker in its shade; from green it gradually changes into blue, then successively into indigo, red, and finally purple.



LIMPET AND DOG-WINKLE.

The relation which the rays of the sun bear to colour is a highly interesting subject of study in chemical science, and probably a careful analysis of the fluid now referred to might disclose some new relation which the sunlight bears to certain substances, and might be of

use in suggesting some process in the arts. Independently of any practical use, however, an investigation into the causes leading to the vicissitudes of colour we have just noticed, would be highly interesting in a scientific point of view.



PELICAN FOOT, SPOTTED TOP, AND COWRY.

The eggs of the dog-winkle (*Purpura*) are still more remarkable than those of the common whelk, already described. These eggs are not attached together in clusters, but placed separate from each other. They are about a third of an inch in length, and are of a most

singular form, being small urn-shaped bodies, supported by a foot, and bearing a striking resemblance to the wooden egg-cups sold in turners' shops.

The Limpet (*Patella vulgata*), of which every rocky shore furnishes several kinds, exhibits much that is remarkable in its structure. The circular disk by which it adheres to the rock is its organ of locomotion; for although it has been supposed to be permanently fixed to one spot, such is by no means the case, for, like other molluscs, it migrates from place to place.

The tenacity with which it adheres to the rock is worthy of notice. This feat is performed on the same principle by which various fishes, such as the lump, the remora or the lamprey, are enabled to attach themselves to flat surfaces, and by exactly the same process as that by which the schoolboy's toy, called a leather-sucker, is fixed to stones or other smooth surfaces.

The circular disk of the limpet's body or foot is applied to the smooth surface of the rock, and by means of the muscles, while the rim of the disk is pressed down very closely, the centre is raised up, thus creating a vacuum between the stone and the animal's body; the shell is therefore pressed down upon the rock by the weight of the superincumbent water and atmosphere, or if the tide be out, by the weight of the atmosphere alone. Thus a shell of which the mouth is but a square inch in diameter, may be pressed down upon the rock it adheres to with a weight of fifteen pounds, and as the conical form of the shell is the most favourable for resisting the external

force of the waves, the limpet has the power of remaining unmoved and in perfect safety in the most violent storms.

As another illustration of the contrivance and wonderful instinct displayed in the common molluscs, let us take one of the commonest, the Netted Dog-whelk, called "netted" because its shell is covered with crossing

NETTED DOG-WHELK.

lines resembling network. Looking at the dog-whelk shells, we observe they have a deep notch cut in the front part, and this mark, trivial as it may seem, is an important indication of the habits of the animal. The inhabitants of all shells which have this notch are carnivorous, while those with simple lips are herbivorous. They gnaw or rather rasp away the tender growth of

marine vegetation. But the dog-whelk acts the part of a cannibal ogre. He feeds on his simpler brethren, storming their stony castles by open violence.

Look at the castle he has stormed; you may pick up hundreds at high-water mark. The empty shell is perforated by a tiny hole near the hinge, so smooth and so perfectly circular, that you would suppose a clever artisan had been at work drilling the massive stony shell with his steel wimble. No such thing: the dog-whelk has done it: this is the breach which he so scientifically effected in the fortress; and hence he sucked out the soft and juicy and savoury flesh of his miserable victim.

In order to understand his plan of operations, let us put down our captive and see him crawl. He is not long before he begins to march. But before he moves he thrusts out a long cylindrical proboscis from the front of his head, which he carries high aloft and waves to and fro; and this organ, we see, fits into the deep notch, in front of the shell. This proboscis is his drilling-wimble.

This organ is itself a study.

Long as it is when extended, it can be thoroughly drawn within the body; and there it forms two fleshy cylinders, one within the other, exactly like a stocking half turned on itself. There are proper muscles attached to its walls, and to the interior of the head, by extremities which are branched in a fan-shape, so as greatly to strengthen their insertions; and these, by contraction, draw the one portion within the other. Then there is a broad hoop of muscle, which, passing round the inner cylinder, by con-

tracting pushes it out, and lengthens it. Within the interior of this latter there is a long narrow ribbon of cartilage, which is armed with rows of sharp flinty points, turned backwards ; and this tongue or palate, as it is variously called, is the dog-whelk's weapon.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## PART V.

## OCEAN-PLANTS.

# THE INHABITANTS OF THE FLOOR OF THE DEEP.

## Part V.

## CHAPTER I.

### OCEAN-PLANTS.

THE bottom of the sea is in many respects analogous to the surface of the dry land; it is diversified with level plains, deep valleys, caverns and rocks, hills and mountains, submerged beneath the liquid element, as the plains, valleys, and mountains of the land are covered by the great aërial ocean at the bottom of which we live.

The analogy is no less strict between the vegetable productions of the sea and the land.

The general distinction is only such as necessarily obtains from the difference between the circumambient fluids in which they have their abode. Thus the stems of marine plants are slender, because they are sufficiently

supported by the dense element in which they grow, and do not require to be thick and strong; their roots also are a mere apparatus for attaching them to one spot, for they gain no sustenance from the root, but from the fluid in which they are immersed.

Some districts of the bottom of the ocean are covered

GROUP OF SEA-PLANTS.

with vegetation so luxuriant that to such districts we might well apply the term of marine forests. The submarine trees bear in some respects a resemblance to many of the most magnificent trees in an American forest; for although not in any way rivalling them in thickness or in solidity of structure, they are their superiors in altitude.

Captain Cook mentions that at Kerguelen Land the sea-weed was of enormous length. In some of the comparatively shallow places the line did not reach the bottom with twenty-five fathoms, and the depth may have been much greater, but the sea-weed grew up in those places from the bottom, not only so as to reach the surface, but spreading over it a profusion of large fronds, and some of the plants were more than sixty fathoms or three hundred and sixty feet in length.

The geographical range of these immense sea-plants extends from the extreme southern islets near Cape Horn to 43° of latitude, a distance of more than fifteen degrees, and more than nine hundred miles, throughout that space affording food and shelter to countless myriads of living creatures of all sizes and varieties.

Other subaqueous regions produce other kinds of vegetation differing from the gigantic sea-weeds now mentioned, as the grass of the prairies differs from the trees of the forest.

The bottom of the sea in many of the inlets on the Indian coasts is covered with algæ and fuci, as a rich meadow is clothed with grass, and there, at a depth of three or four fathoms, dugongs in immense herds browse like cattle in a meadow. But between the comparatively short marine herbage on which those huge herbivorous animals feed, and the enormous sea-weeds of the Southern Ocean, there exists a vast number and variety of species, many of those pertaining to tropical seas wholly unknown to the marine botanist.

Our own coasts afford many sea-plants; in many instances of much beauty, in some of very considerable value and importance, and in all cases of much interest to the intelligent observer. Before, however, taking notice of a few of these, some general observations may not be out of place.

The growth of marine plants on our shores is, according to the most eminent botanists, limited to certain localities on the coast.

Thus some of our sea-weeds have their northern limit on the southern coasts of England; others belong peculiarly to the Scottish coasts and the northern shores of England and Ireland; some, again, have a wider range, extending from the south of England to the north of Ireland and south-west of Scotland, and others even to Orkney and Shetland along the western shores of both islands.

As regards depth, our marine plants are likewise variously distributed. Some sea-weeds extend to the line of ebb at spring-tides, some belong to an inner line within which they become partially uncovered every ordinary tide; others, again, flourish within the line of the neap-tides, and become entirely uncovered at each recess of the water, and others occupy stations so shallow and near the shore, that they are frequently, and for a considerable period at one time, left almost dry.

It thus appears that there are certain boundaries or limits within which certain kinds of algæ are found to flourish; but so far as can be ascertained at the depth

of fifty fathoms in the British seas, the vegetation is scanty.

The various species of sea-plants on our shores amount to about three hundred and seventy.

VARIETIES OF SEA-PLANT.

(1) *Cystoceria.* (2) *Dictyota.*

Some of these are large, some so minute that their structure can be examined only with the microscope.

They all exhibit great variety of form. Some are composed of broad, ribbon-like leaves or fronds; some are

VARIETIES OF SEA-PLANT. (3) *Chondrus*.

like long strings of brown cord; others have leaves very similar to those of terrestrial plants; others, again, are

like strings of beads, tufts of silk or velvet, network, bunches of slender hairs, tubes of glass filled with colouring matter, or minute trees with spreading branches and numerous slender twigs; in a word, the utmost diversity of form prevails.

All the marine plants are flowerless. Their fructification differs from that of the class which produce blossoms, and this peculiarity may be readily observed by examining in autumn the back of a fern-leaf, or frond, on which a multitude of seed-like bodies may be seen grouped together in various forms.

The highest forms of marine plants are composed of the same elements as the most simple. They all consist, not of organs related to, and affording nutriment to each other, as the root of terrestrial plants does to the branches, but of a series of separate and independent parts.

In several marine plants there are various parts analogous to those of land vegetables, such as roots, stems, branches, and leaves. But between these parts of marine plants there is no difference of organization, all being alike formed of cellular tissue, and each part appearing to have an independent existence, and not to participate in the common vitality of the vegetable.

There is another peculiarity in the structure of sea-weeds extremely worthy of notice. To perceive this peculiarity it is requisite to refer to the structure of the higher orders of terrestrial plants. In these the root is the part of the plant which absorbs the moisture requisite

to their growth. Liquid absorbed is transmitted from the root, along with any chemical ingredients it contains, to every part of the plant, for the nourishment and growth of its several parts.

Now, in the sea-weeds, the only function which the roots perform is that of fixing the plant to its place. It has no power whatever of transmitting moisture to other parts of the plant, the cells forming the plant being entirely insulated from each other. Accordingly, while in the majority of terrestrial vegetables the power of absorption is restricted to the root, this power in sea-weed is distributed over every part of the surface, for the obvious reason that it is entirely immersed in the fluid from which its nutriment is extracted. As a consequence, therefore, if a sea-weed be partly raised out of the water, the portions so deprived of their source of nourishment will wither and die from drought, while the portions which continue immersed will continue to thrive, without transmitting any moisture to the part of the plant raised out of the water.

Intimately connected with the subject of the physiology of the sea-weed is that of the artificial uses to which they are adapted, the peculiar properties they possess, and the purposes which in nature they fulfil.

Many of them are of no inconsiderable importance and value to mankind.

Chloride of sodium is found in their tissues, and the carbonate of soda used in soap-making is produced by the decomposition of this chloride. The chloride is driven

off, and the carbon and the sodium combine with oxygen, and the chemical result is the carbonate of soda or kelp.

Another important use to which marine vegetables are applied, is that of manure in the cultivation of land. Marine plants contain in large quantities those various ingredients, such as phosphates, earthy and alkaline carbonates, that are requisite to enrich the land and

ROOT OF SEA-PLANT (*Laminaria*).

render it capable of producing plants of whose composition these ingredients are a part.

The gathering of sea-weed for the purpose of manure and for fuel exhibits in the Channel Islands a busy and picturesque scene.

Another use to which some species may be put, is that of supplying food for pigs and cattle. It is applied to this

important purpose in the Western Isles, and in several parts of the northern coasts of Europe. The animals fed upon it are said to thrive remarkably well, a result to be anticipated from the chemical constituents of the plant.

From marine plants the chemical substance called iodine is extracted. This substance is of very great value in medical practice, possessing great efficacy in reducing glandular and other tumours.

One kind is considered most nutritious as well as agreeable food. It is eaten raw by the natives of the Scottish coasts, and in former times was regularly brought to market in the larger cities.

When boiled, another produces a gelatine of very nutritious qualities, which may be used at table in various forms. From its restorative properties, the mucilage may be taken with advantage by those suffering from debility, or from affections of the lungs.

From one kind the edible birds'-nests are formed, which are considered so great a delicacy by the Chinese, and even by our own countrymen who have partaken of them. These nests are brought from certain islands on the Chinese coast, where there are caves in which birds resembling swallows build for themselves these remarkable habitations, employing for the purpose a species of sea-weed, which they subject to the process of maceration before applying it to its purpose.

But the chief use of these plants of the sea is fulfilled in their place in the deep—they afford shelter and food to countless hosts of animated beings who inhabit the waters.

It is now fully understood that on the land the great source of oxygen requisite to animal life is the vegetable kingdom; that a continued reciprocation of benefits, so to speak, takes place between animals and plants, the latter consuming the carbon produced by the former, and the former living on the oxygen exhaled by the latter.

The same process is carried on beneath the waters.

The marine animals which live upon sea-plants also require oxygen, without which their vital functions cannot proceed. This oxygen their organs of respiration separate from the liquid element in which they live. But the sea-water would thus soon cease to be capable of supporting its countless hosts, if some provision were not made for the renewal of the life-sustaining fluid strained from it by the respiration of animals.

This renewal, however, is effected by aquatic plants. Like land-plants, they are the great source of oxygen; affording, therefore, food and vital air to the denizens of the deep.

THE END.

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